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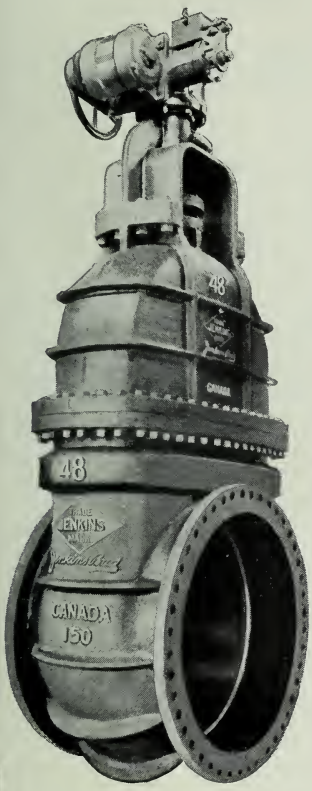

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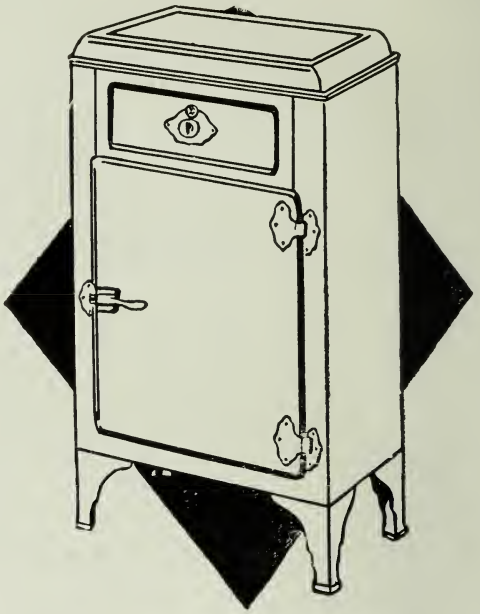

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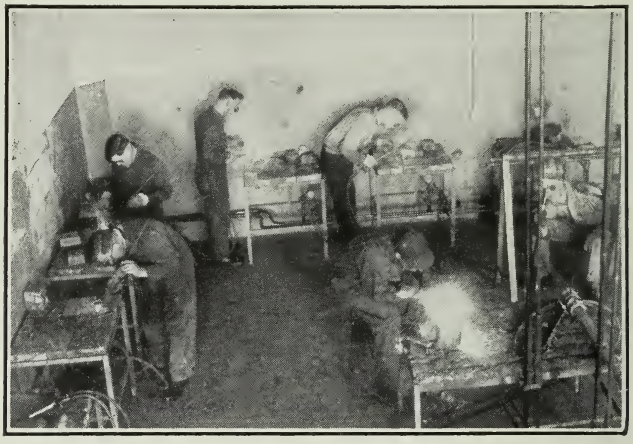

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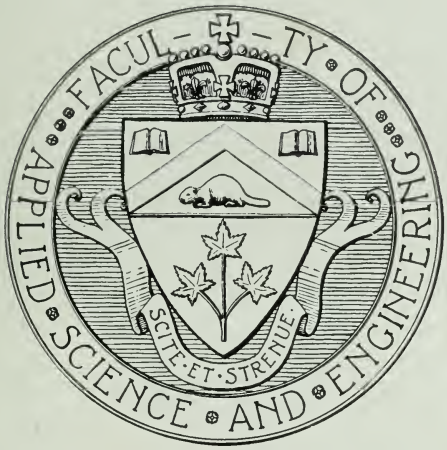

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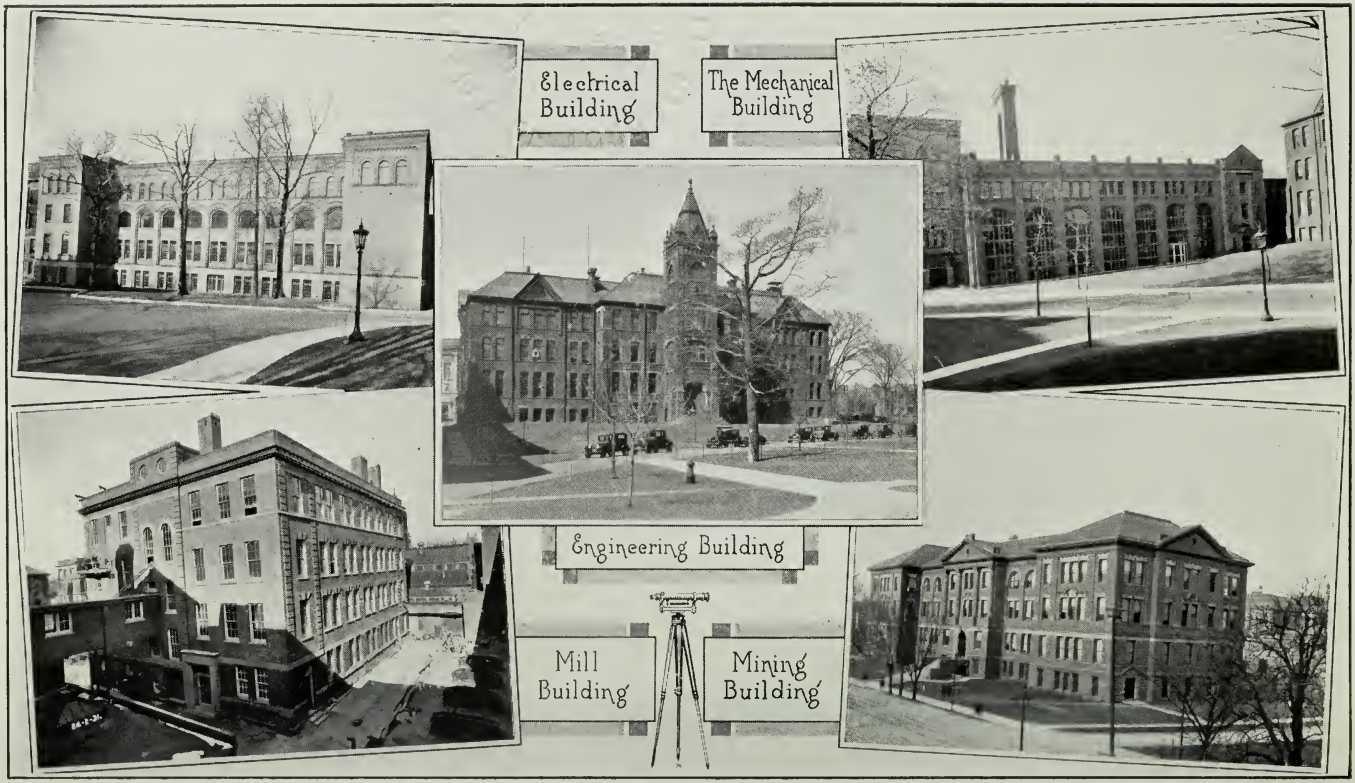
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TRANSACTIONS AND YEAR BOOK

OF THE

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No. 46 APRIL, 1933

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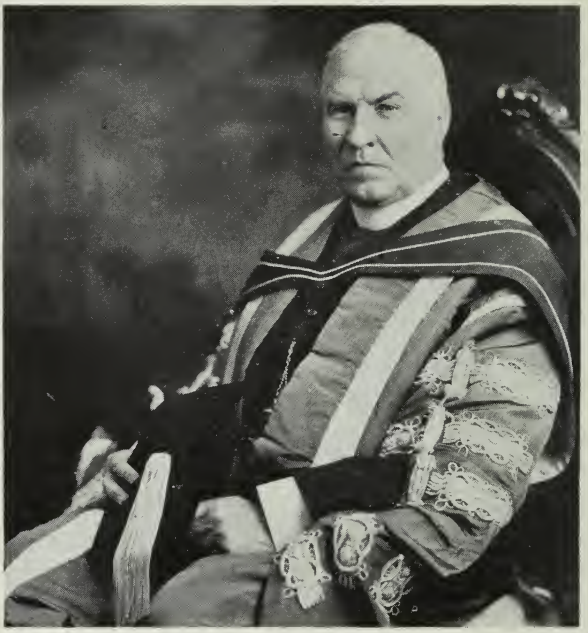
EDITORIAL

IN assuming the entire responsibility for the editing of this copy of TRANSACTIONS the board returns to the policy of the editors of the 1930 and previous editions. For the past two years a member of the faculty has acted in an advisory capacity to the board. In this act of the editors in placing one of their professors in such a post there is something of a gesture of respect and veneration, but there is also the less pleasing aspect of shouldering onto an already busy person the added work and responsibility of such a position. So we of the board of editors present this copy to you as a work of the students themselves and hope that it will meet with your entire approval.

This year has been a very difficult one for the business staff. A great deal of credit is due to our business manager Monty Werry for his unstinting sacrifice of time spent on this work. We would also like to thank our advertisers who have stayed with us despite conditions, and to assure them of the consideration of every Schoolman in the market for their goods.

It is the sincere hope of the board of editors and all those who have helped so materially to put this edition in print that its technical and year book sections will prove of both instructive and interesting nature. In some distant day when you pick up this edition and thumb through its pages may it recall to you some of your School friendships, your struggles and your good times, and may it help to bind you closer to that great body of men the world over—the graduates of old School.



THE HON. AND REV. H. J. CODY, M.A., D.D., LL.D.
President of the University of Toronto

MESSAGE FROM PRESIDENT CODY TO THE ENGINEERS

It is a pleasure to send greetings to the members of the Engineering Faculty of the University of Toronto. My own recollection of this important group in the University takes me back to the days when the School of Practical Science had an independent existence, under its first honoured Principal, John Galbraith. The University Commission of 1905-6, of which I was a member, recommended that this School become the Faculty of Applied Science and Engineering in the University; and in due time this recommendation was acted upon.

Your Faculty has always possessed an abounding vitality and energy, even though disguised under the "meekness and peacefulness" with which poetry has endowed you. The graduates have taken an active part in the loyal support of our University, and in the material development of our country. I know you will continue so to do. The trained engineer becomes the constructive citizen. The years immediately ahead may try the souls of men; but sooner rather than later they will offer opportunities and challenges to the best that is in us. I hope you will find a sphere of work in Canada and be able to give your fullest measure of service to her upbuilding. And I am confident that the University will find no more enthusiastic and helpful sons than the graduates in Applied Science. May every success attend you and may even hard times give you the joy of enduring and evercoming.

H. J. Cody

THE DEAN'S MESSAGE FOR 1933

To the Members of the Engineering Society:

The past year has been a most successful one in the Engineering Society and it has had outstanding features which will distinctly mark it in the history of the Society.

The addresses which are published in this volume of transactions, have had a high quality and have had a diversity which will prove useful. A feature of the year has been the careful business administration in which all have cheerfully co-operated. This is important in these difficult times where care is necessary in expenditures, not as in former years where the revenue has been limited, due to smaller membership, but where, as this year, there has been a large revenue due to the large number of members—greater than ever before in the life of the Society. There have been many functions and activities during the year, all carried out most successfully, both from a business and a social point of view.

I wish to congratulate the President and Officers of the Society upon this successful year and to compliment the Director of Publications and his committee upon this creditable number of Transactions.

You who are graduating, go out this year to a world that is in something of a turmoil and in a very marked process of transition. Engineering and all activities in Applied Science are in the middle of this because these activities are so much bound up in progress and prosperity. You who are remaining to continue your studies here, may have to face changed conditions when you graduate but in any case, graduating or remaining, all of you are in a profession which will be the first to recover after the depression has passed.

There is no fear that engineering graduates these days will not be absorbed into these activities in due course, because they will be sure to be wanted. There *is* a fear, however, that when young engineers go out under conditions that are uncertain, such as now obtain, when confusion exists and when even leaders are perplexed, they may lose some sense of proportion, may lack some appreciation or may miss some inspiration.

If I may offer advice it is: stand steady, do not be drawn aside by catch-word phrases or faddist theories. Keep to good sound lines, hold to your ideals, maintain your perspective and above all exercise your own good common sense, the common sense that you have learned here. These, with the School spirit, will carry you through.

C. H. Mitchell,
31st March, 1933. *Dean.*

PRESIDENT'S MESSAGE

Fellow Schoolmen:

On three occasions now have I read the address of the retiring President in Transactions. On each occasion too, does the president mention regret, and one might thoughtlessly conclude that such was the accepted form of saying "good-bye". Whatever were my opinions previous to this moment, I am now thoroughly convinced that each president was sincere in what he wrote. A feeling of regret certainly does creep over a person when the time comes to have his final say and hand over the ship.

The amount of pleasure I have derived from holding the office of President none but a past president can imagine. For this pleasure and high honour, I am greatly indebted to you. These are not mere words, gentlemen. I should very much like to thank each one of you personally and individually. In the Freshman edition of "Toike Oike" I made an appeal, as the new president, for your co-operation. I can now say that I received that co-operation absolutely and completely, to me an inspiring reflection of your confidence.

A review of the Society's activities show that another successful year has been completed. Candidly it was a difficult one. It was the policy of the Society to reduce the selling price of many supplies to directly benefit the students. Reduced prices reflected in reduced revenue, and in our ceaseless efforts to curb expenditures, we have earned the title of "Cut-Down Meeting" for nearly every gathering that is called behind those frosted windows in the office.

After the preliminary worries of by-election and initiation were disposed of, the Society got under way. The next big event to come was the School Dinner. That is something we were all greatly pleased with. As you were told at the time, the Society loses money on every man that attends, but we like it. At one time the men were asked to pay exactly what it cost, with a small attendance as a consequence. Under the present system we can put on a dinner which has no equal on the campus. The next big event was "School Nite", which along with others is written up elsewhere. We do feel that we started something this time, and the possibilities

are enormous. Then the "School At-Home" was a function never to be forgotten. Rigid economy made it possible to come within the budget in spite of the times. The class of the dance did not suffer in any way, and it is held in great prestige among the other faculties.

The meetings of the Engineering Society were well attended and proved interesting. The old worries of poor attendance are largely past, for the men realize that they miss something by not attending. All the above events are properly dealt with elsewhere, and I merely call attention to them. The Athletic Association, although not part of the Society is intimately connected with it. School's name has always been upheld by our athletes and this year was no exception. When we get that Mulock Cup next year it would be rather fine to have Sir William present it at the School Dinner.

Well, this rambling of mine could go on for pages but there are the readers' feelings to be considered. You have a brand new executive coming in, full of new hopes and ideas. Clarence Tyson will make a splendid president I am sure. His whole group of henchmen look good to me too. In closing, I want to thank all the executive with whom I had the pleasure to work. Then I wish to thank the men who took charge of School Dinner, School Nite, School At-Home, Elections, etc. It certainly was a help to be able to hand over those responsibilities and know that the job would be done properly. Best of luck to all of you in your exams, your summer activities, in fact in everything.

STEWART BALL.

1933

TRANSACTIONS

OF THE

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

FACULTY OF APPLIED SCIENCE
AND ENGINEERING

UNIVERSITY OF TORONTO

HIGH STRENGTH CEMENTS

Condensed from a Thesis for the Degree of B.A.Sc. in Civil Engineering.

BY W. R. MCCOLL

Interest in the high strength concrete so extensively used in Europe led the author to gather together his impressions of current knowledge of the part which cement plays in such concrete into a thesis of which this is a portion. While the production of cement is essentially a chemist's work, nevertheless it seems that no civil engineer can hope to use the material to advantage unless he appreciates what it is, how it reacts, the products of reaction, how it hardens and all those phenomena which affect the structure in which it is to be used.

Portland cement is essentially a mixture of finely ground argillaceous and calcareous materials, which, when burned to incipient fusion in a kiln and then ground again, gives a product that, when mixed with water, gives what might be termed a mineral glue. It is a glue that binds sand and stone together into an artifiicial stone that can be reinforced in tension and about which will be developed an architectural style as characteristic of it as Gothic was of stone.

Generally it is accepted as a constant quantity even by men who meticulously differentiate between the various grades of steel, or timber. A glance at Fig. 1 will at once show the fallacy of such an assumption. Modern cements, particularly the high strength brands, have acquired individual characteristics unknown a few years ago. When an engineer contemplates using these improved cements he must consider these characteristics. This work is an effort to indicate in a general way, only, the causes of these variations.

Hardening of Cement

In 1906 Michaelis advanced the first colloid theory to explain the binding properties of cement which has displaced the previous theories of hardening which accepted the process as being one of crystallization. This is probably best stated as by Bates and Klein of the U.S. Bureau of Standards some years ago:

"Hydrated Portland cement as a binder must be considered largely as an inorganic glue, and furthermore, it has many of the properties of an organic glue; in other words, it is largely a reversible colloid. Fish or bone glue which has been used to cement two bodies (as two pieces of wood) together will, if placed in water, swell to an extent that it will lose all its adhesive properties; if allowed to dry out, it will reach such a stage that it will again recover all its cementitious properties, and, further dried out, it will again lose this, being reduced to a very friable material.

"Portland cement acts in a somewhat similar manner though ordinarily this cannot be followed as readily, owing to the character

of the materials cemented together. These are invariably dense and do not allow ready access of moisture to the cement. Also, the colloidal matter formed from the cement does not allow ready passage of moisture."

The colloid theory of hardening supports and is supported by the water-cement ratio and void-cement ratio theories. It is not difficult to visualize the existence of a probable relation between gel concentration and the water-cement ratio, since, in plastic mixes, the volume of water closely parallels the void space. It has been shown that for a given mix, strength is usually proportional to the density of the concrete. Either side of the optimum water content the density is reduced. In one case the voids are filled with water which dilute the colloid; in the other the voids are mostly filled with air and the colloid surrounds the cement particles in a highly concentrated state. In both instances there is increased space to be filled with the colloid during the curing. As the change in concentration can only take place in the liquid or solution phase, it indicates that for the best curing it is necessary that moisture be present.

Composition and Chemistry

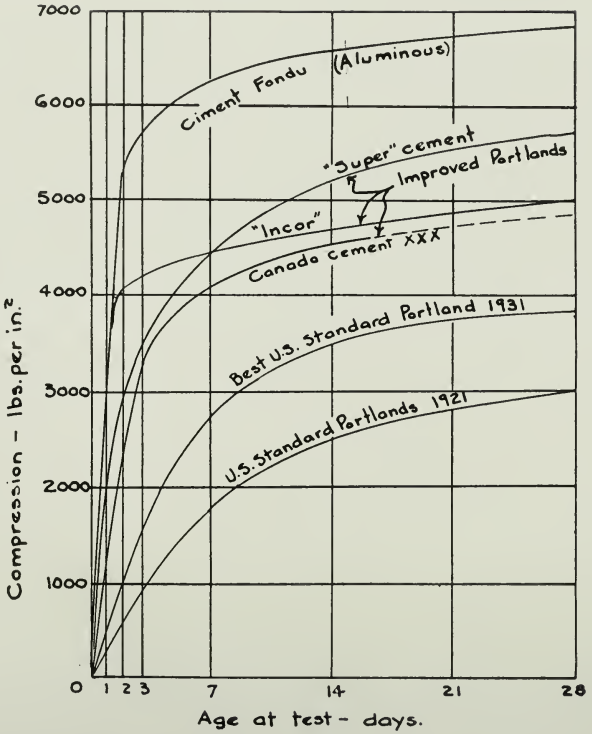
To understand cement one must follow it through its manufacture. In Fig. 2 is shown graphically approximately the proportions of raw materials which, when finely ground, are burned to incipient fusion in the kiln. The iron and alumina are essentially kiln fluxes. The products of the kiln, which are combined in the mass known as cement clinker, are shown in the order in which they are developed in the kiln and which, with a few minor variations, are generally accepted.

The product of hydration and hydrolysis which result when the cement is made into a water paste are shown in Fig. 3. Gypsum is added at the grinding of the clinker to retard the formation of the tricalcium aluminate which would otherwise cause the cement to harden so quickly on the addition of water as to give a "flash setting." The tricalcium silicate has hydrolysed sufficiently to render some strength after twenty-four hours while the dicalcium silicate does not normally render any strength until at least seven days. All effective hydration has been commenced within twelve hours of mixing the concrete.

The last two reactions of Fig. 3 are of unusual interest in this discussion. The tricalcium disilicate ($3CaO.2SiO_2$) is the gel or colloid which is the glue in cement, the hardening of which, as has been explained, imparts strength to concrete. The $Ca(OH)_2$ shown is ordinary slaked lime freed during the hardening of the cement. Though of minute size the particles surround and penetrate the gel, binding the aggregates together in considerable quantity.

The value of a greater yield of this gel is easily realized for, within limits, the greater the quantity of gel the greater the strength of the concrete. The importance of the freed lime is probably not so quickly appreciated. Scattered as it is throughout the entire

FIG. 1—STRENGTH-AGE CURVES



Water-cement ratio 0.8
Values from manufacturers' data
Ciment Fondu: 4:2:1 mix, 7% water by weight.

FIG. 2.

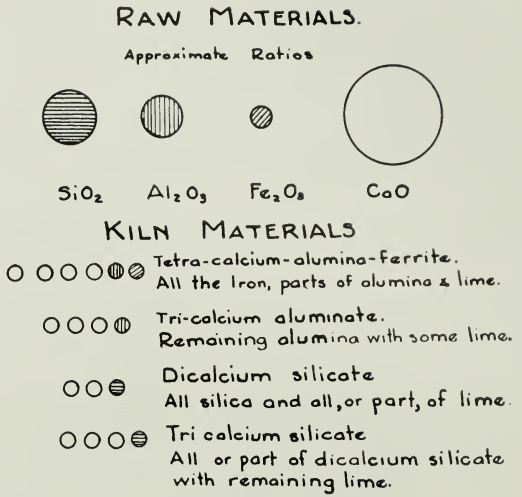


FIG. 3.

PRODUCTS OF HYDRATION & HYDROLYSIS.

$$4CaO\cdot Al_2O_3\cdot Fe_2O_3 \longrightarrow 3CaO\cdot Al_2O_3\cdot 6H_2O + CaO\cdot Fe_2O_3\cdot nH_2O$$

$$3CaO\cdot Al_2O_3 \longrightarrow 3CaO\cdot Al_2O_3\cdot 6H_2O$$

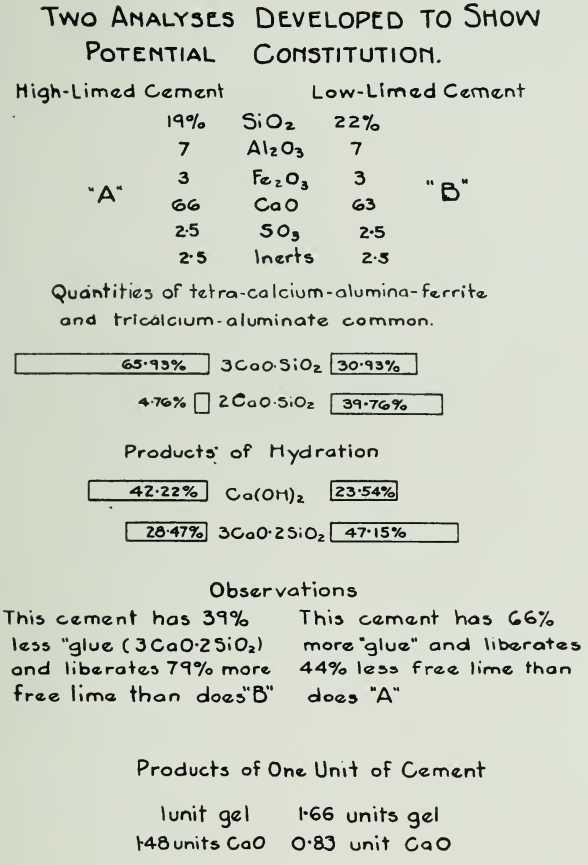
$$2CaO\cdot SiO_2 \longrightarrow 1\tfrac{1}{2}CaO\cdot SiO_2\cdot 2\tfrac{1}{2}H_2O + \tfrac{1}{2}Ca(OH)_2$$

$$3CaO\cdot SiO_2 \longrightarrow 1\tfrac{1}{2}CaO\cdot SiO_2\cdot 2\tfrac{1}{2}H_2O + 1\tfrac{1}{2}Ca(OH)_2$$

At least 90% of cement after reactions is included in the last three major substances.
—R.K. Meade.

concrete and being so active chemically it renders the concrete susceptible to the action of acids and alkalies so common in sea water, bog drainage, industrial wastes and sanitary sewage. Indeed the pure glacial waters in mountain regions have dissolved so much of this lime as to have seriously impaired some dams. When the lime is removed a very permeable concrete is left which is exposed to the terrific forces of frost in every pore. Permeability in concrete

FIG. 4.

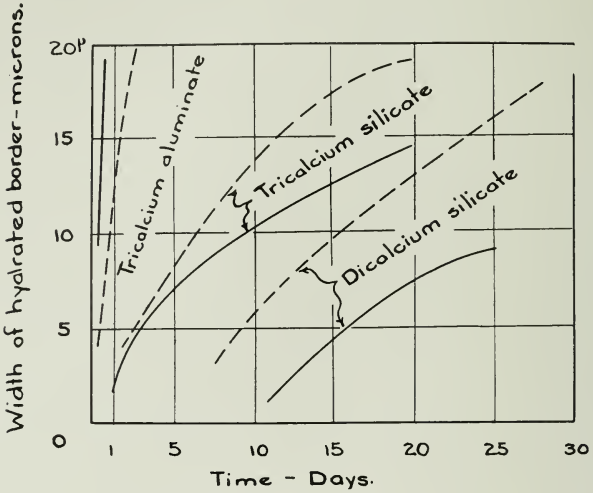

TWO ANALYSES DEVELOPED TO SHOW POTENTIAL CONSTITUTION.
High-Limed Cement
Low-Limed Cement
"A"
"B"
19% SiO2 22%
7 Al2O3 7
3 Fe2O3 3
66 CaO 63
2·5 SO3 2·5
2·5 Inerts 2·5
Quantities of tetra-calcium-alumina-ferrite and tricalcium-aluminate common.
65·93% 3CaO·SiO2 30·93%
4·76% 2CaO·SiO2 39·76%
Products of Hydration
42·22% Ca(OH)2 23·54%
28·47% 3CaO·2SiO2 47·15%
Observations
This cement has 39% less "glue (3CaO·2SiO2) and liberates 79% more free lime than does "B"
This cement has 66% more "glue" and liberates 44% less free lime than does "A"
Products of One Unit of Cement
1 unit gel
1·48 units CaO
1·66 units gel
0·83 unit CaO

means a porosity that causes high local stresses and low breaking point average stress.

It was shown in Fig. 3 that the tricalcium silicate component of cement yields three times as much lime per mol of gel produced as does the dicalcium silicate. Hence a cement so constituted as to yield much lime is known as a "high lime" cement. In Fig. 4 two cements having apparently quite similar chemical compositions are developed to show the great difference in their potential compositions. In accordance with well-established chemical laws a small

FIG. 5—RATES OF HYDRATION

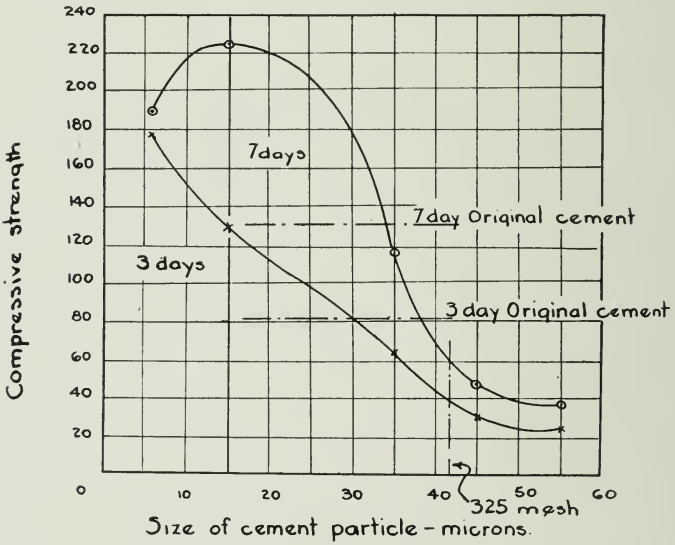
Tricalcium aluminate, tricalium silicate, dicalcium silicate. From Bulletin No. 61, Engineering Experiment Station, Ohio State University.



Size of particle tested was greater than 50 microns in diameter. Dotted line indicates rate of hydration using 50% $CaCl_2$ solution.

FIG. 6—PARTICLE SIZE & STRENGTH-AGE RELATIONS

Plotted from work of Prof. Dr. Hans Kühl.

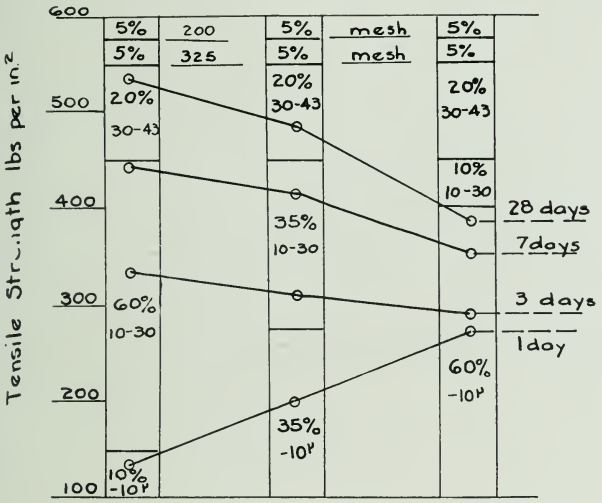


"Original cement" refers to cement from which fractions were separated by sedimentation in oil.

Notice that there was not sufficient 20-30 micron size here to permit testing.

difference in lime and silica entering the kiln causes a great difference in the ratio of the tricalcium and dicalcium silicates produced. As a result there is a great difference in the yield of the gel and freed lime in a concrete. The weaknesses due to high freed lime have been recognized by the U.S. Army engineers in charge of the construction of the huge Hoover Dam who have specified cement having a low tricalcium silicate to dicalcium silicate ratio showing that the problem is not one of mere speculative interest.

FIG. 7—SELECTIVE GRINDING



Showing strength-age characteristics of various particle sizes present in any cement with a view to establishing an optimum blend. 1:3 mortar specimens. 30-43 indicates cement with particle diameter greater than 30 microns but smaller than 43 microns. Separation of sizes by means of air separation.

Remembering always that early strength in a concrete is a highly desirable feature the tricalcium silicate has, apparently, a great advantage over the dicalcium silicate as may be seen in Fig. 5. This characteristic is the basis of the patented process of "double burned" cements so widely advertised in the United States. In these cements a very high portion of the cement is tricalcium silicate. In using such a cement to produce early strength one must recognize its capacity for yielding more free colloidal lime, as illustrated in Fig. 4, and the influence of such on the durability of the concrete. This high tricalcium silicate to dicalcium silicate ratio explains why the strength-age curves of such cements show such a pronounced flattening after the very rapid initial rise to strength in from two to five days. (See "Incor" in Fig 1.) Later strength always comes from the dicalcium silicate and if this is lacking later strength increases will also be lacking.

FIG. 8—SELECTIVE GRINDING
Data as for FIG. 10.
1:3 mortar specimens.

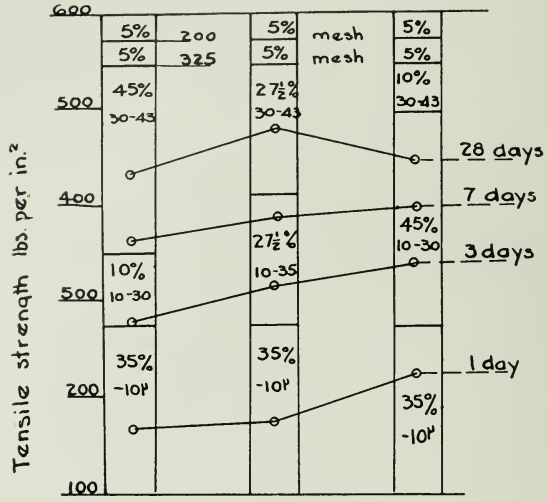
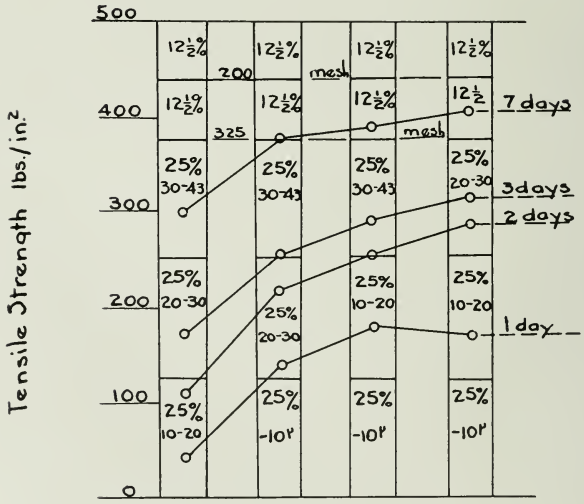


FIG. 9—SELECTIVE GRINDING
Data as for FIG. 10.
1:3 mortar specimens.



The problem as has been recognized by some workers has been to hasten the reaction of dicalcium silicate. A catalyst at once suggests itself. An indication of the effect of calcium chloride on hastening the development of strength is shown in Fig. 5. Other catalysts to be added during the manufacture of the cement will undoubtedly be developed. The effect of one such catalyst is shown in Fig. 1 in the case of "Super Cement." In such a cement some one and two day strength formerly contributed by the high-lime-yielding tricalcium silicate is sacrificed for a more durable concrete developing greater strength after about one week. A concrete made with such a cement shows a strength-age curve with less tendency to flatten after the initial rise to strength.

Grinding

Since Smeaton ground the first artificial cement to a fineness which would permit it to pass about a modern fifty-mesh sieve there has been a constant effort to gain a more finely ground cement with every improvement in grinding yielding a proportional increase in strength and durability. The limits to which finer grinding results in better cement (*i.e.,* one rendering high early strength) was reached a few years ago. Feret found that, while very fine grinding hastened the hardening, the advantage in strength over cement of normal fineness was ultimately lost. These observations led to the instigation of much current research the results of which are just now appearing in publications.

While present specifications permit as high as twenty-two per cent. of the cement to be coarser than a two hundred-mesh sieve seldom does more than two to six per cent. of high strength cement remain on such a sieve. Tests show that there is little value in that cement that does not pass the 325-mesh sieve for producing the desired gel. This is appreciated when one considers that tricalcium disilicate gel concentration is affected from within by the continued hydrolysis of the cement particle. So, with a large grain, the outer surface reacts chemically and the low-lime silicate gel is precipitated on that surface. This gel, even though soft at first, is relatively impervious so that, as the inner unhydrated mass of the cement grain draws the water from the surrounding layer of gel, drying and hardening it, the inner gel, when and if produced, is never active as a binder.

Helbig quotes a case in "Zement" where fine grinding increased the strength in the ratio of 1:1.9 while the water permeability was decreased in the ratio of 1:56. It was found in British tests that the best cements which are invariably finely ground developed from one to two times the bond stress at seven days as did the British specification standard cement at twenty-one days. This is of particular significance for bond stress is of considerable importance in reinforced concrete design.

Some interesting results on the strength-age relation of all sizes of cement are shown in Fig. 6. As may be seen from the curves the finest portion of cement gives the highest three-day strength

though it shows almost no further strength at seven days. At three days the finest cement particle has not only completely reacted chemically but the gel has almost hardened. The second finest portion, made up of the cement particles having a diameter of from fifteen to twenty-five microns (a micron is 1/25,400 inch), while showing about seventy per cent. of the three-day strength of the finest portion shows the remarkable increase of about seventy-five per cent. of its won strength between the third and seventh days. This gives the second portion a marked advantage in the matter of seven-day strength. As previously stated that cement not passing the 325-mesh sieve is of little value.

The strength-age relations existing in various combinations of these particle groups are very interesting. Fig. 7, 8 and 9 which are the work of an American laboratory show the results for various combinations from which is deduced the proper blend. Fig. 10 shows that the one-day strength comes almost entirely from the finest portion of cement while all later strength comes from the larger sizes. The values in Fig. 8 suggest the early activity of the smaller particles of the ten to thirty micron size cement and hence the combinations shown in Fig. 9.

In the first of these combinations of Fig. 9 there is no material smaller than ten microns so that any gain in strength in the first twenty-four hours must be attributed to the presence of twenty-five per cent. of the ten to twenty micron class of material; this is about forty pounds. In the second cement twenty-five per cent. of the minus ten micron size material has been substituted for the same quantity of the ten to twenty micron material so that the strength gain in twenty-four hours must be attributed in this case to this twenty-five per cent. of the finest material; this is equal to about 140 pounds. In the third cement the twenty to thirty micron material has been eliminated in favour of the ten to twenty micron class. Now any gain in the one-day strength is due to the presence of the two finest cements. If the theory is correct this strength at one day should be the sum of the strengths of the first two classes of particles. It is about 180 pounds which supports the reasoning. In the fourth blend the largest active portion (thirty micron to the 325-mesh) has been removed in favour of the twenty to thirty micron class. This substitution does not affect the one-day strength at all though there is a noticeable increase in the two-day strength which advantage is carried into the seventh day.

The ideal cement is some combination of these last two cements. The combination must be established for each cement as there will be variations due to kiln characteristics and chemical composition. By using the ball mill for grinding the clinker it is possible to control the fineness grading of the finished cement absolutely. This is done by varying the size and number of the combination of balls and tubes in the mill as well as the speed of the mill. That some such control is necessary is shown in Fig. 6. This cement contained so little twenty to thirty micron material that there was not sufficient to permit testing this portion.

EFFECTS OF TEMPERATURE ON FERROUS METALS

Condensed from a Thesis for the Degree of B.A.Sc. in Mechanical Engineering.

BY T. F. TAYLOR

That the properties of metals, with regard to strength, hardness, etc. vary with temperature is well known. But just how these properties vary quantitatively is at present being thoroughly investigated. The field is a broad one, so that in this paper only the ferrous metals will be considered. Their changes in properties with temperature will be treated from the standpoint of the mechanical engineer, with attention directed more to strength and permanency of dimensions, than to the metallurgical, chemical and theoretical changes involved. As the properties at normal temperatures are well known, they will not be discussed. Attention will be directed principally to the high temperature region, because it is at high temperatures that many serious problems are being encountered to-day. Ferrous metals are almost universally used in high temperature work.

The following examples may give some idea of the temperatures which are now common in power plant work, in the chemical industry, and in metallurgical and foundry processes.

Part	Temperature at Which Used °C.
Boiler tubes	600 to 700
Still tubes (Oil refining)	500 to 700
High pressure steam lines	500
Turbine cylinders and rotors	450
Furnace hangers (For supporting tubes, etc.)	1000

Some steam lines run so hot that they would glow in the dark if they were not lagged.

It is apparent that these temperatures embrace the range in which a number of metallurgical changes take place, such as the change of gamma iron to the austenitic form in carbon steels, the spheroidization of the iron carbide, the loss of all hardening effect in the case of heat-treated carbon steel, etc.

Spheroidization is an important effect. When carbon steel in the pearlitic form is heated just below the Ac_1 point for some time, the iron carbide collects in globules among the ferrite. This is known as spheroidization, and results in greatly reduced resistance to creep strain or plastic flow when carrying stress at elevated temperatures, which is a serious thing.

It is known from experiment that, if there be residual cold work, or even effect from forging, in the specimen, the rate at which spheroidization will take place is greatly accelerated. Sufficient annealing at say 900° C. is said to remove such effects.

It has long been believed by metallurgists that spheroidization of the iron carbide takes place only over a narrow range of temperature below the lower critical range. It has been found, however, that spheroidization can take place as low as 470° C. (1)

R. W. Bailey, England, states that there is a relationship between the rate of spheroidization and the absolute temperature, as given by the equation (1)

$$t = A\, e^{\frac{b}{T}}$$

where t is the time required
T is the absolute temperature
e is the base of the Naperian Log.
A and b are constants, found by experiment.

This relation has been checked experimentally, and has been found correct within the limits of experimental error. While spheroidization may take place very slowly at temperatures of say 500°C., yet a great deal of time is allowed for this change to occur, as for example in a steam turbine, which may have a useful life of 100,000 hours or more.

A second important change in the micro-structure of the metals has to do with the material which cements the crystal grains together. At room temperature a steel or iron will fracture through the grains, and not at the grain boundaries. This indicates that the cementing material is stronger than the crystals. But at high temperatures, fracture takes place along the grain boundaries, which indicates that the cementing material has become weaker than the crystal grains. The temperature at which the grains and the grain cement have the same strength is known as the equi-cohesive temperature.

The unique property of growth is exhibited by cast iron. When a coarse-grained iron is subjected to repeated heating and cooling, particularly when exposed to certain corrosive agents, such as steam, hydrogen sulphide, and certain salts, it increases in volume, and becomes weak and useless.

There are believed to be several causes of growth. When the pearlite in the iron breaks down into graphite and ferrite, above 500° C., it occupies a larger volume than before. The heating and cooling also result in thermal stresses which may cause minute cracks in the metal. Corrosion may take place in each of these cracks, if the iron is in a corrosive medium, with a resultant increase in volume and decrease in strength. If the heating and cooling cycles include the region at 700°C., the allotropic changes which take place there may be a contributing cause.

However, it is known that coarse grained porous castings are most subject to growth, particularly if exposed to oxidizing gases. Dense, sound castings, of good design, may not be seriously affected by growth up to 350°C. Certain nickel chromium alloys are much more resistant to growth and corrosion than plain grey iron, and may be employed up to 800° C. Figure 1 (2) shows curves for

ordinary cast iron (A) and for a nickel chromium iron (B) known as "Ni-resist."

The changes in the microstructure of the metal, such as spheroidization, and the weakening of the inter-grain cement, would not concern us if they did not alter the physical properties.

This leads to considerations of the strength and the permanence of dimensions of ferrous metals at high temperatures, which is the important factor from the standpoint of construction, providing conditions of corrosion are satisfactory. Due to its importance, this phase will be treated in more detail.

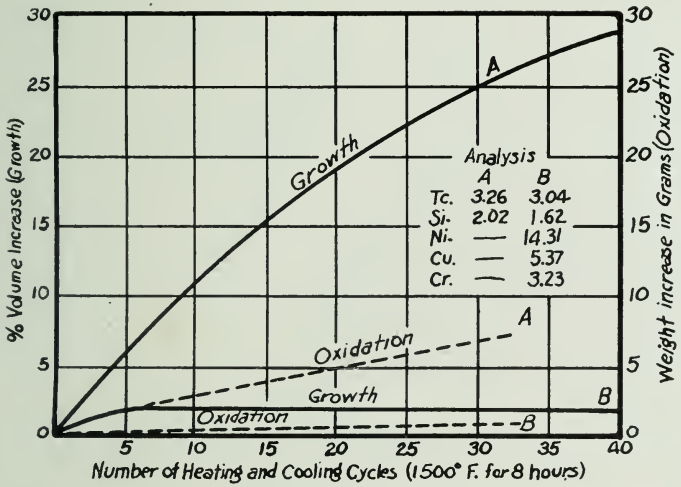


FIG. 1—Typical Curves of Oxidation and Growth of plain Cast Iron A, and Corrosion Resisting Cast Iron B, at 1500° F.

Since antiquity, engineers have known that as iron approached a red heat, its strength became lower, until at forging temperature the metal was no stronger than lead, and could be deformed as easily. When accurate figures on strength at high temperatures were first required, the logical solution was to test a specimen, say in tension, in the usual manner, with some provision for maintaining the specimen at the desired temperature. Its yield point and ultimate strength at this temperature could thus be found.

This method was employed as early as 1837 by the Franklin Institute, U.S.A., and was the only method used until about ten years ago. Parts for high temperature service were designed on such test figures, using suitable factors of safety. However, continued trouble was caused by the failure of these parts after a more or less lengthy period of service, even when factors of corrosion or micro-structural changes were not to blame.

This problem was brought up by Mr. E. S. Dickenson, in 1922. He drew attention to the fact that steel at red heat would in time fail when subjected to loads much below the yield point as found by the usual tests. He advanced the theory that the metal slowly

but continually deformed when under load at high temperatures. This continuous deformation is commonly termed creep.

To help understand creep, the following analogy may be considered. If steel at normal temperature be loaded slightly beyond its elastic limit, some deformation takes place, which raises the yield point of the steel by the cold working effect, until the load can be carried without further deformation. There is a considerable range of stress over which this strain hardening can take place. If the temperature of the steel be raised, the region over which strain hardening occurs is progressively reduced, until finally no

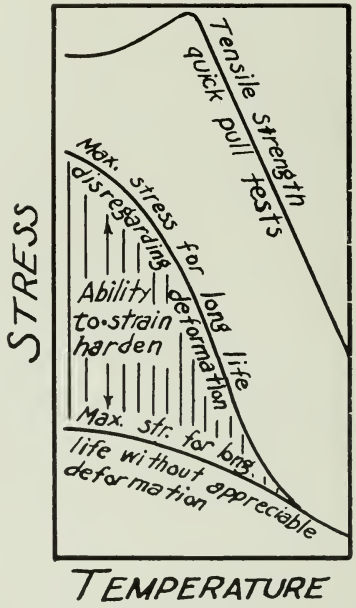

STRESS
Tensile strength quick pull tests
Max. stress for long life disregarding deformation
Ability to strain harden
Max. str. for long life without appreciable deformation
TEMPERATURE

Fig. 2—Diagram showing the character of the relations between stress, temperature, time and elongation in ordinary structural steel.

strain hardening whatever will occur. Under these conditions, if the specimen be loaded beyond its elastic limit, it will yield till it fails, with no increase in strength. The creep under such conditions would, of course, be much greater than could be allowed in practice. However, this action may help explain the slow deformation that does occur for stresses much below the elastic limit. This analogy is shown diagrammatically in Figure 2 (3).

Another consideration has to do with the cohesion between the crystal grains, which has been mentioned before. It is rather generally believed that creep, and the condition of the inter-granular structure, are linked together. The inter-granular cement is amorphous, and in common with other amorphous materials, such as glass, is brittle to sudden shock, but will flow slowly under

steady stress, if the temperature is right. You may have noticed, that in pulling out a piece of red hot glass, a steady pull will still cause slow elongation, just as the redness is fading out, when a sudden jerk would have broken the glass. It may be that the inter-granular cement acts in somewhat the same manner, allowing the crystal grains to slide past one another very slowly, when the temperature is high enough.

Some authorities believe that metals creep at all temperatures, and none seem to dispute this idea. But it is known, from engineering experience, that if there be creep at normal temperatures, it is so small as to be below the limits of measurement, even when continued over a period of years. An experiment is now being carried out, in Sheffield, England, on a piece of rustless austenitic chromium nickel steel at room temperature, to check this theory. This experiment is being carried out for a period of twenty years.

The rate of creep which may be allowed material in engineering use is very small. The following limits are generally quoted as being about right. (4)

Part	Permissible Creep Rate per Hour
Turbine disks, shrunk	10^{-9}
Bolted flanges, turbine cylinders	10^{-8}
Steam piping, welded joints, boiler tubes	10^{-7}
Superheater tubes	10^{-6}
	or 10^{-5}

For example, the creep rate of 10^{-7} per hour for boiler tubes means a yielding of $\frac{1}{10,000,000}$ inches per inch per hour. Taking 10,000 hours in a year, the permissible elongation on one inch for one year would be $\frac{1}{10,000,000} \times 10,000 = .001$ inches. The permissible elongation for material in a shrunk turbine disk would have been .00001 inches per inch per year.

The standard tension testing machine is utterly unadapted for such work, and consequently new apparatus had to be devised.

Such testing apparatus must perform three functions.

1. It must maintain the specimen at any required temperature with accuracy, for a period of months. Variation in temperature would result in linear expansion of the test piece, which would upset measurements of elongation.

2. It must be capable of maintaining a constant or gradually varying load on the specimen.

3. Provision must be made for measuring accurately the extension of the specimen.

In the most recent apparatus, the specimen is held in a vertical position, and load is applied by means of weights, through levers. The required temperature is obtained by surrounding the specimen with a small cylindrical electric furnace, the temperature of which is maintained automatically by a thermocouple and relays. Meas-

urement of extension may be made by dial micrometer for large strains, and by optical micrometer, or Martens mirror type extensometer for low creep rates.

The apparatus used by Metropolitan-Vickers, England, is the best that the writer has seen described, and is typical. It is shown in Figure 3. (1) The screw and link mechanism placed half way along the lever is used to carry load during the time the specimen is being adjusted to constant temperature, after which the load can be quickly and gently transferred to the specimen.

Creep tests are sometimes carried out for periods as long as six months or a year, in order to get measureable elongation with a stress and temperature approximating those which can be used in practice.

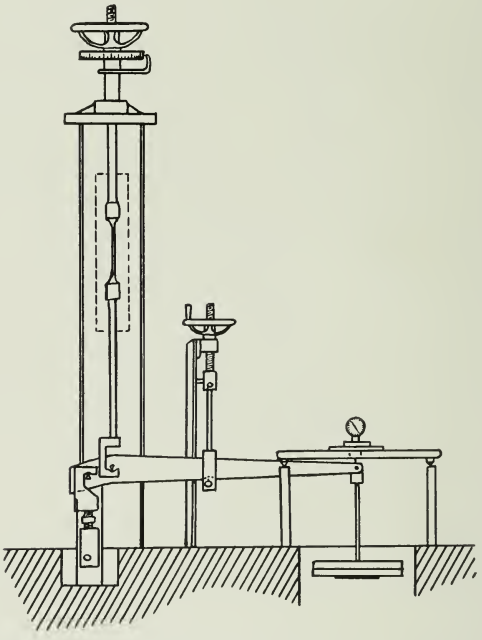


Fig. 3—Metopolitan-Vickers Creep Apparatus.

It is apparent that such lengthy tests are a serious handicap to investigators. As a result many attempts have been made to devise some comparatively quick method for determining creep rates. These involve the use of stresses much above those permissible in practice, in order to cause measureable strain in a few days or weeks. These results must be extrapolated to apply to stresses and rates of creep which are practical. Unfortunately there is no known definite relationship between stress and strain at these high temperatures. Therefore, the extrapolation, if it has been extended far, is likely to be seriously in error. This has perhaps been one of the biggest factors in causing the confusion that

is at present associated with creep tests. In tests which are made under approximately working conditions, the accurate measurement of the minute elongation obtained is difficult, and per cent. errors are apt to be high, particularly if there are slight variations in the temperature of the specimen. Any slight variation in the composition, or in the origin or heat-treatment, may have a profound influence on the characteristics at high temperatures. This last factor has undoubtedly been responsible for a number of the variations in test results.

R. W. Bailey, an authority on creep, in a recent paper, wrote, "No mechanical tests upon apparently similar materials carried out by different laboratories have shown such disconcerting differences in their results as creep tests." And two engineers (5) in the steel industry said in 1931 that "Until a standard method of determining accurately the elastic limit of steels at elevated temperatures by a short time test becomes available, we cannot consider, for design purposes, any data bearing on this property, as the variation in true elastic limit is too great, even though there appears to be fair agreement in the values for tensile strength, elongation, and reduction in area."

These two quotations indicate to what little extent available data on creep strain may be trusted. Therefore, rather than give a number of test results on definite alloys, which results will soon be superseded by more accurate ones, the interpretation of these test results will be considered in detail, with a view to their practical application in design; and so that the reader may judge better what results are worthy of consideration, and to what extent.

The results of creep strain tests may be set down in a number of different ways. A typical curve obtained by the ordinary quick-pull test is shown in Figure 4 (6). This is an alloy called "Supertemp," made by the Bethlehem Steel Company, meant specially to carry load at elevated temperatures. It shows a slight rise in strength at about 400° F. (200° C.), with an accompanying increase in brittleness, as shown by the drop in the elongation and reduction of area curves. This region at 200° C. is known as the "Blue Brittle Range," and is common to steels. The strength then falls rapidly with increase in temperature. This curve is typical of quick-pull results on steels, and is of little use to the designer, because there is no way of determining from such curves the rate of creep for a given temperature and stress. These tests give only a rough idea of the comparative strengths of metals at high temperatures.

The next type of curve is that which shows directly the experimental results. A typical series are shown in Figure 5 (3), which were taken from tests done by the Bureau of Standards at Washington. These curves require little comment. It will be noted that stresses applied are impractical for engineering use, because the rates of creep are too high. Tests made with stresses which give creep strain much greater than can be tolerated in practice are of little direct value, but give a comparison between the creep resistance of metals. In Figure 6 (1) is the same type of curve published

this year by an English laboratory, in which the stress is one that could be applied directly in practice. After the fast initial creep the strain seems to settle down to about $\frac{.0001}{8}$ inches per inch in 2000 hours. (The specimen was 8 inches long.) That is, a creep rate of $\frac{1}{80000 \times 2000} = 6.25 \times 10^{-9}$

The initial strain is a characteristic of all parts subject to creep. When load is first applied to the specimen, the stress will not be evenly distributed, due to internal strains in the metal, or eccentric loading. Therefore some particles will be overloaded, and creep

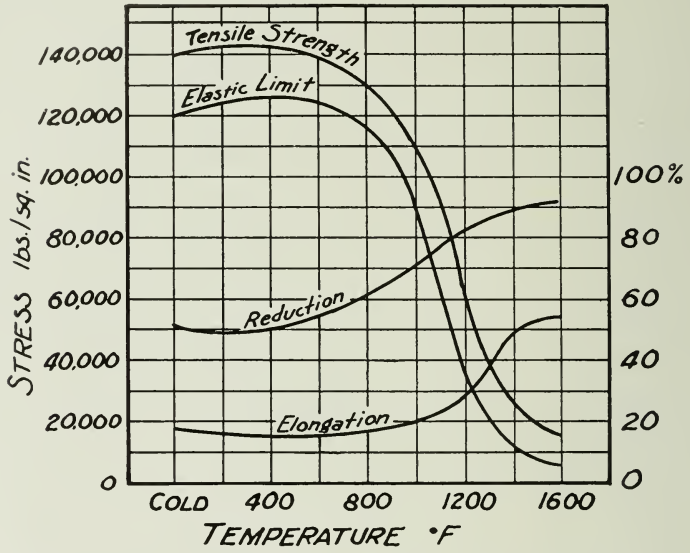


Fig. 4—Typical Quick-pull Results for Steel. High Alloy Cast Iron.

will commence at a high rate. As strain takes place, the particles which were understressed gradually assume more load, thus bringing the stress to a more uniform condition over the specimen, and reducing the rate of creep. As the stress becomes more and more uniform, the rate of creep will approach a steady value, but will not reach that value until the stress is absolutely uniform. This seems like a logical explanation. The fast creep which takes place first is called initial creep, and that which takes place at a fairly constant rate for the life of the specimen is called secondary creep. Nearly all of the initial creep effect may take place in a few hundred hours, but the true secondary rate of creep may not be reached for thousands of hours.

Thus creep may be divided into two stages, first the initial creep, and then the secondary creep. From Figure 6 it would appear that the initial creep was more serious than the secondary

creep. This is true over a short period of time, but untrue over a long period of time. From Figure 6 the initial creep on the specimen is about .0005 inches. In 100,000 hours the secondary creep would amount to $100{,}000 \times 6.25 \times \frac{1}{1{,}000{,}000{,}000} \times 8 = .005$ inches,

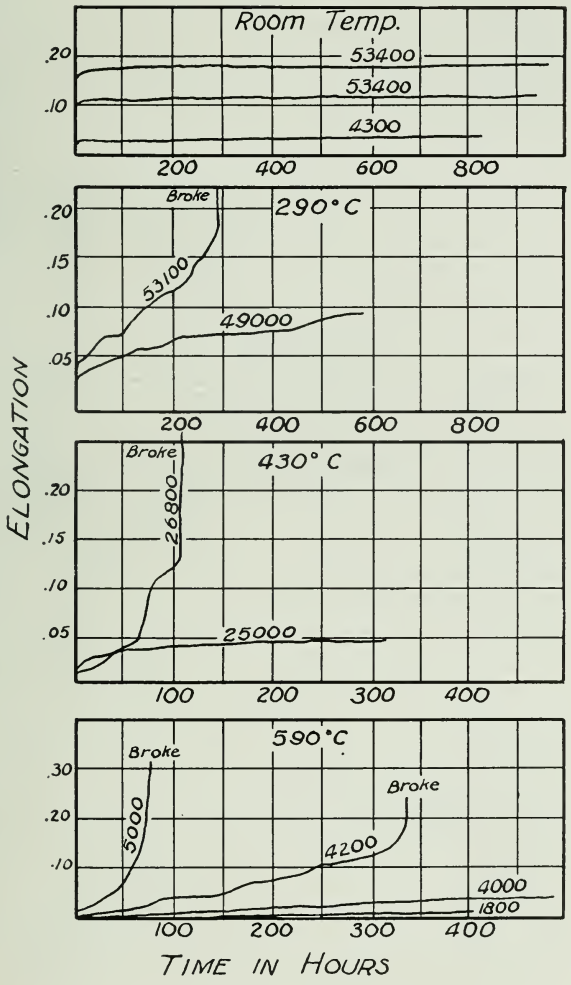


Fig. 5—Creep Strain Curves.

or $\frac{.0005}{.005} = 10$ times the initial creep. It is important to know whether a given creep rate is secondary creep, or total creep over a given period of time, which is a combination of initial and secondary creep.

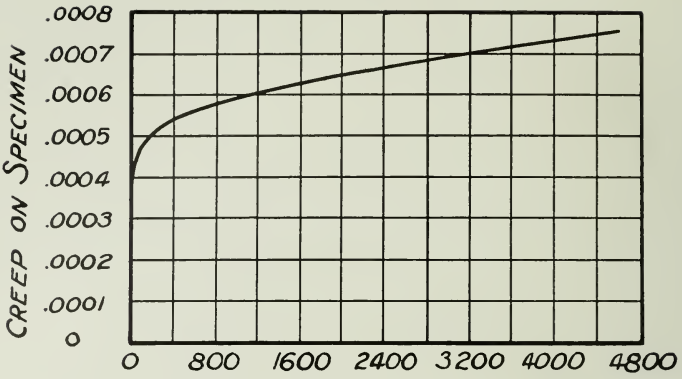


Fig. 6—Temperature 400° C.

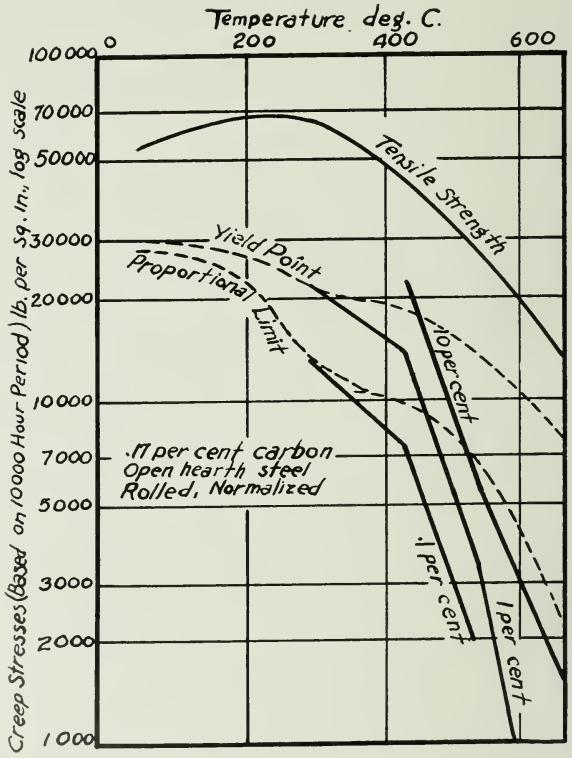


Fig. 7—Stress Temperature Curves for Long Time and Short Time Tension Tests Plotted with Logarithmic Stress Ordinate.

From a number of test results made with different stresses at different temperatures, curves based on creep rate, temperature, and stress may be plotted. Such curves are most useful to the designer, but reliable ones in which all terminology is made clear, and in which complete data concerning the test specimen are given, are hard to find. One type, from the National Physical Laboratory in England, is shown in Figure 8 (1). In it the axes are temperature and creep rate. By minimum creep rate is meant the closest approach to the secondary creep rate obtained in the test. Figure 7 shows a similar type of curve based on creep in 10,000 hours (7). As this creep is a combination of initial and

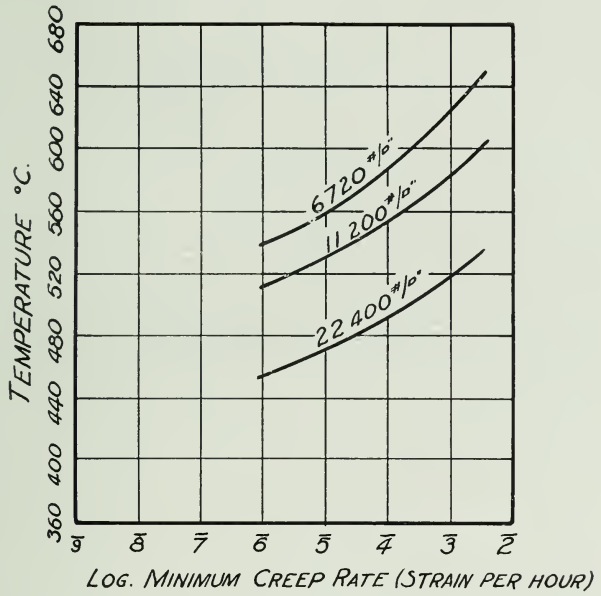


FIG. 8—Creep of 0.4 per cent. Carbon Forged Steel.

secondary creep, the amount of creep to be expected in the next 10,000 hours is not known. In this case the axes are temperature and stress. The advantage of the logarithmic scale used for stress is that it spreads out the creep curves at low stresses, where their values are most important.

There are a number of other types of curves and ways of expressing results, but most of them are based on the ones already shown.

The effects of temperature on ferrous metals covers a vast field, because there are so many ferrous metals, the temperature range is wide, and there are many different permissible rates of creep, depending upon the use to which the steel will be put. Until recently the state of knowledge on the subject was not sufficiently advanced to be able to formulate wisely a code for the testing of creep. But now the experimental results are so numerous and so diverse as to be

almost overwhelming. It would seem that the wise thing to do would be to standardize the tests and the methods of presenting the results to such a degree that test results could be compared with some accuracy and convenience. Then, perhaps, little by little, our knowledge on this important and interesting subject could be crystallized and confirmed, and the results used to better the design of all ferrous products subject to high temperatures.

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RECENT DEVELOPMENTS IN OXWELDING AND CUTTING

Address by W. A. Duncan, District Service Engineer of the Dominion Oxygen Co., Ltd. to University of Toronto Engineering Society, January 27, 1933

We have given to this Society, on previous occasions, presentations covering in detail the Procedure Control for Oxwelding, the importance of a High Test welding rod for steel welding and a survey of the numerous applications of the process in various industries. To-day, as our subject implies, we are going to attempt to cover particularly the newer developments and uses of the oxy-acetylene welding and cutting process which have been accomplished within the last year.

In covering the subject from this angle, we realize that a large number of those present to-day may not have heard our previous presentations and will therefore not have the background referred to. For this reason we will not assume too much on your previous knowledge of the process, in describing the newer applications.

The fact that the past year has shown a very healthy development in the use of the oxy-acetylene process is a direct indication of the fundamental usefulness of this all-purpose method. In the oxy-acetylene welding and cutting process is found a tool ready to meet all industrial conditions of production, maintenance and repair, alteration, and demolition. Indeed, for almost any use to which the oxy-acetylene flame is put, it becomes generally adopted as being a more efficient and economical tool for the purpose.

Notable among the developments in the oxy-acetylene process during the past twelve months are found improved equipment as well as improved use of already existing equipment, improvements and advances in new uses of the process, and more efficient application to the entire range of commercial metals and alloys. Hand in hand with these developments are found advances in the testing of welds, which, of course, are necessary in order to meet the constantly increasing demand for high quality workmanship.

Joining

Outstanding among the recent developments in the oxy-acetylene joining of metals is the Lindeweld process which has revolutionized pipe line welding practice since its introduction two years ago. During the past year application of the Lindeweld process was extended to the welding of tubular joints in aircraft. Joints in unusually thin tubing, which previously had not been satisfactorily made by any other means, have been successfully made by this welding procedure. Joints of higher efficiency are obtained, particularly after heat-treatment and it is expected that this process will be used increasingly in aircraft welding.

Another noteworthy step in the joining of metals has been the almost unprecedented advance in the use of bronze-welding for joining all types of metal. With the great stress which is being laid upon maintenance and repair of broken parts, as well as the necessity for stronger joints during fabrication and production work, the new all-purpose bronze-welding rod developed during 1932 has been found to be ideally suited for meeting these present-day demands in industry.

Due to the greater ease of application and the superior physical properties of this bronze rod, welds joining steel can be readily made with strengths between 56,000 and 60,000 lbs. per sq. in., and with ductility in excess of 30 per cent. These results approach those obtained with the High Test steel welding rods and are much better than those obtainable with low-carbon steel welding rod where tensile strength in the weld rarely exceeds 50,000 lb. per sq. in. As a result of this development, bronze-welding is now being employed in many new applications and it merits universal consideration as the most widely useful method of welding known to industry.

An important application of bronze-welding where large deposits of bronze are built up in sections is in the repair of fractured cast iron machinery frames and bases. Some of the largest frames in use have been successfully reclaimed by this method. Other well known examples of cast iron parts repaired by bronze-welding are automobile cylinder blocks and locomotive steam cylinders. Cast iron pipe joints are bronze-welded in the foundry and field to secure strong, leakproof and permanent connections.

Malleable iron castings are usually small in size and are readily repaired by bronze-welding. In production, small malleable iron castings are bronze-welded to sheet metal parts and containers.

Bronze-welding is now used on wrought iron in ornamental iron work, especially where a fusion weld would not be practicable. For the same reason, it is extensively used for numerous products of sheet metal, and for heavier iron and steel sections.

Under certain conditions, the new all-purpose bronze rod has been found to be of exceptional value in the manufacture of metal furniture. When the surfaces to be joined are clean and bright, strong and ductile welds can be made without the aid of flux. Painting or enamelling can be done immediately without the necessity of removing flux adhering to the weld.

Galvanized pipe joints, together with underground storage tanks, ranges, boilers and other containers made of galvanized sheet metal are best fabricated by bronze-welding since the galvanized coating of the joints is least affected by this welding method. Bronze itself is very resistant to corrosion.

Steel castings, plates and shapes are frequently bronze-welded, especially if the higher temperature of fusion welding is not desirable because of possible distortion, or to avoid preheating in the welding of heavy sections.

Copper, nickel and many alloys, whether in the form of castings or plates and shapes, can often be bronze-welded to give

results equal or superior to fusion welding. This is especially true if the color match is unnecessary and when it is desirable to simplify fabrication methods. Certain brasses and bronzes, however, melt at a temperature so near that of the bronze welding rod that fusion welding must be employed rather than bronze-welding.

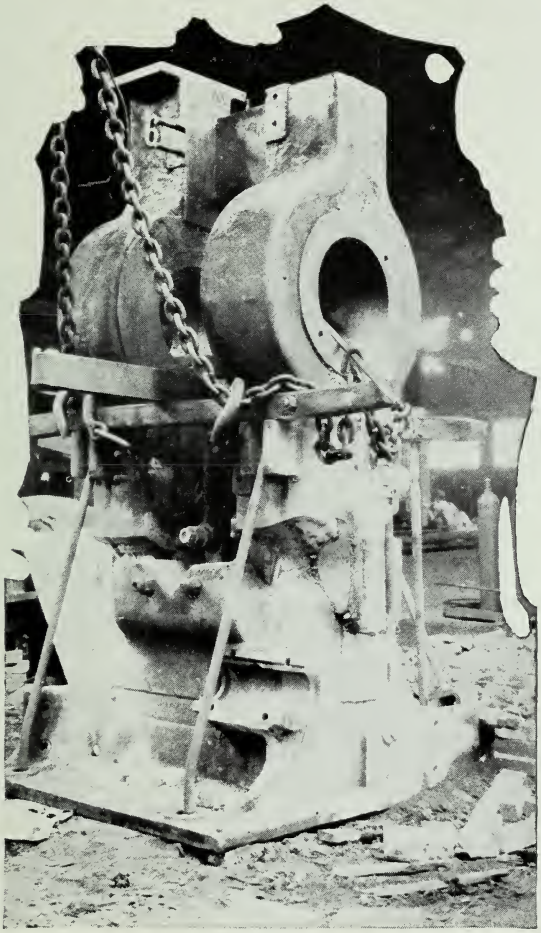


Fig. 1—Largest bronze welded job in Canada.

This new bronze-welding rod alloys readily with most of the commercial metals in this class, and if the welding procedures recommended are carefully followed, joints of high strength and exceptional soundness, free from porosity, can be made by the operator of average ability.

Severing and Shaping

Until comparatively recent years the oxy-acetylene cutting process has been used primarily as a severing tool. In this capacity it has performed a wide variety of cutting operations in all commercial thicknesses of steel and at very low cost. In a number of respects, particularly those relating to cuts of irregular contour in rolled or forged steel, this process has developed to be of the greatest utility, being able to trace, singly or in multiple, complicated geometric shapes or patterns within very narrow tolerances.

The accurate performance of this cutting tool for heavy gauge steel is credited with having greatly expanded the commercial use of such material for it has enabled economical preparation of these heavy thicknesses for fabrication, thereby encouraging their use in fields hitherto closed, such as machinery housings, major pressure vessels, structural slabs and plates.

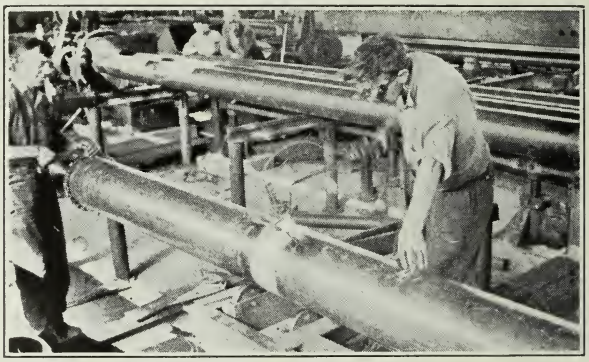


Fig. 2—Double lengthening steel pipe with the semi-automatic machine.

During the past year this process of severing has been developed to the point where cuts of great accuracy and within extremely narrow tolerances can be made on a commercial basis. As brought out in a technical paper recently, precision cutting to within a few thousandths of an inch is being obtained in $1\frac{1}{4}$ in. thick plate through careful set-up of cutting apparatus.

Undoubtedly the outstanding development of the use of the oxy-acetylene cutting or shaping flame lies in the Flame Machining process, whose elementary function is largely that of surface oxidation much in the form of tool planing. Wide strips of lineal areas are removed from the surfaces of steel stock and logically, therefore, this constitutes a branching out of the cutting process into a new field.

The deseaming blowpipe—a blowpipe developed for doing one branch of Flame Machining work—has been applied increasingly for the conditioning of semi-finished steel in steel plants and for surface-removing operations in steel foundries, forge shops and

other steel working plants. By means of a low velocity jet of oxygen issuing from a comparatively large nozzle, grooves up to 2 in. in width and $\frac{3}{8}$ in. in depth can be cut with linear speeds of from 15 ft. to 30 ft. per min. by the average operator. Under certain circumstances, higher speeds are possible.

A further development of flame machining is known as flame milling, which consists of sinking a planing cut by means of the planing nozzle to produce a typical milling cut on a steel round. In fact practically all of the roughing operations such as turning, drilling, boring, and other types of milling are being carried out, although in some cases still experimentally, with a great deal of success. It is expected that the use of the blowpipe for this type of work will revolutionize practices in the removal of metal in steel

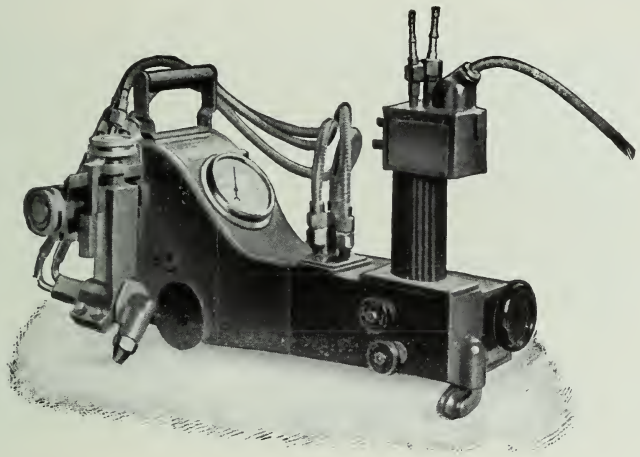


Fig. 3—D.O.C. Secator—Portable Automatic Shape Cutting Lindewelder.

forming as well as in the removal of excess metal, cracks, checks and other defects from steel castings and forgings, and in preparing vees for butt type welds in thick plate.

During the past year a technique has been developed which permits a skilled operator to cut 18-8 chrome-nickel steel risers to within close tolerances. This is an advance which is important in that the use of such oxidation-resisting steel is constantly growing every year.

Rebuilding Worn Surfaces

Worn surfaces form one of the most frequent causes of maintenance operations in industry. In the past a worn surface has usually meant that the part would have to be scrapped and therefore lost completely, necessitating an expenditure for a replacement part. To-day, however, worn surfaces are rebuilt to the required dimensions either with the use of a hard-surfacing material such as Stellite, where the surface must undergo heavy abrasion, with the

new, all-purpose bronze welding rod, or, occasionally, with a rod of composition similar to that of the base metal.

During the year, a greatly increased use of a hard-surfacing material has been observed. Its use has become standard practice in a large number of plants in a wide variety of industries. Shutdowns, repairs or replacements are no longer the inevitable result of wear, and production time is no longer lost while equipment stands idle awaiting replacement parts. This is entirely due to the use of the rebuilding operation. Even where hard-facing is applied to new parts, the additional cost is more than offset by the greatly increased life of the part. In many cases, hard-facing is applied to parts which would otherwise be discarded as useless for further service. A most important feature of hard-facing is the fact that the operation can be repeated an almost unlimited number

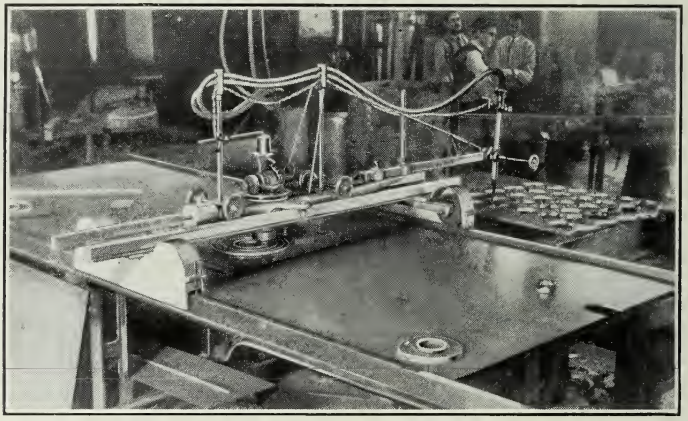


Fig. 4—Oxweld shape cutting machine.

of times on the same part. Thus, when a hard-faced part eventually shows signs of wear, it can be quickly restored by another application of the material. The ease with which these wear-resistant materials may be applied, coupled with greatly increased life of the parts given this treatment, has led to the establishment of this process as standard in industries.

During the year, a marked improvement was made in the practice of hard-facing oil well drilling tools through the development of composite welding rods in which various screen sizes of sharp grains of tungsten carbide are uniformly distributed in a binding material.

The past year has also shown a tremendous increase in the use of the bronze-welding process for rebuilding worn surfaces. Typical parts that have such surfaces built up with bronze are: pistons, from those of the largest steam engines to the smallest pumps; sliding valves and seal rings in pumps; broken or worn gear teeth; shafts and spindles, yokes, pins and clevises such as become worn

in motor vehicles. The worn areas are built up oversize with bronze and are then machined to the proper size or fit. Small bushings can be renewed by filling up the hole in the cast iron or steel part with bronze and then drilling out to size. In some instances machining is unnecessary, as in the case of water wheel runners or impellers where areas are worn by the action of sand in the water.

Non-Ferrous Metals

Although the oxy-acetylene welding of aluminum is in itself not a development of the past year, the fact that to an even greater extent industry is learning that this metal is best welded by the oxy-acetylene process constitutes a notable item. The necessity

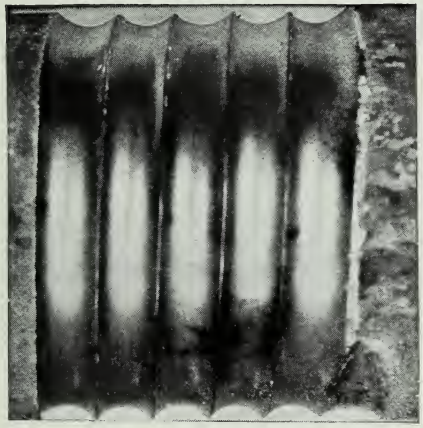


Fig. 5—Flame Machining.

for lowering production costs in aluminum fabrication work has resulted in a thorough study of the cost of welded aluminum products.

Recently the results of intensive investigation in the fusion welding of brass, bronze and other copper base alloys were made known. Outstanding among these results was the definite recommendation for the use of an oxidizing welding flame rather than the previously used neutral flame. It was found that by adjusting the flame to the proper excess of oxygen, stronger, entirely non-porous and sound welds were made possible in these copper alloys.

Testing

Probably the important advance in testing during 1932 lies in the tremendously increased stress placed on the qualification of welders. This part of "Procedure Control" is steadily assuming greater importance as it is being realized that the human element

in welding must be reduced to the minimum in order to assure a high standard of strength and soundness in the finished product.

Qualification tests consist of various standard destructive tests applied to welded specimens made by the welder under conditions as nearly as possible approximating the conditions he will have to meet when actually working. Much investigation of these tests resulted in standards being proposed and adopted by regulatory and supervisory bodies. This marks a distinct advance.

In the realm of non-destructive testing of welds in finished products, great progress has been made, in the use of both X-ray and gamma ray methods.

This brief outline of the definite progress in the uses of Oxwelding and cutting in industry is encouraging in these years of marking time or retrenchments seen in most industries. It is a definite proof of the growth of "welded mindedness" on the part of the captains of industry, and of the fundamental soundness of the process as a modern method of joining and severing metals.

INTERCONTINENTAL COMMUNICATION

Summary of an Address before the Engineering Society on November 16, 1932

BY MR. D. G. GEIGER, TRANSMISSION ENGINEER OF THE BELL TELEPHONE COMPANY

The progress that long distance electric communication is making in bringing into closer relationship the various peoples of the world is, perhaps, nowhere more interestingly illustrated than in the developments which, in the last few years, have taken place in the interconnection of widely separated wire communication networks by means of overseas radio-telephone links. It is the co-ordination of these networks into a world-wide telephone system that has challenged the best efforts of the communication engineers.

Speech was first transmitted across the Atlantic from Washington to Paris in 1915, but, due in part to the delays during and succeeding the war, commercial traffic was not handled between New York and London until 1927. Since then forty intercontinental circuits have been established, the London-Sydney one 10,600 miles, being the longest. Service is now given between any Bell System telephone in North America and Great Britain, practically all of Europe, Ceuta and Morocco, part of Australia, New Zealand, Union of South Africa, Siam, Balearic Islands, Egypt, Java, Sumatra and the East Indies, Argentina, Brazil, Chile, Uruguay, Peru, Bermuda, Hawaii, and the Canary Islands.

This means that a Canadian telephone subscriber can be connected with any one of nearly 33,000,000 other telephones in the world, which is 92 per cent. of the world's telephones. There are still to be connected in this network such areas as Japan, China, the Phillipines, Alaska, and parts of Africa and South America, in none of which is the telephone development large.

As an example of the methods used to solve some of the difficulties of this type of communication the problems encountered on the New York-London circuits will be discussed in greater detail.

Radio Circuits

Two one-way radio channels are used on this circuit, but due to the necessary economy of wave lengths, both use the same frequency. This necessitated a special terminal network at each end, to prevent speech from flowing from the receiving circuit back to the transmitter, due to small unavoidable unbalance in the hybrid coils connecting the subscriber to the transmitter and receiver, and so causing an annoying echo at the speaking subscriber's end.

When a subscriber speaks special relays connect him to the transmitter and open the receiving path, and at the other end the receiving path is closed and the transmitting opened, so that

the listening subscriber cannot break in as long as the first subscriber is talking. When he finishes speaking the relays drop back to normal, and the second subscriber may speak.

Long Wave Radio Channels

For transoceanic telephony the range of long waves from 40 to 100 kilocycles are suitable, but only for the temperate zones where static interference is moderate and for distances up to 3000 miles.

The first Transatlantic channels were those of 58.5 and 61.5 kc. providing a band width of 3 kc. The American transmitter is at Rocky Point, Long Island, and the British receiver at Cupar, Scotland, while the British transmitter is at Rugby and the American receiver at Houlton, Me., thus placing the receivers as far north as is convenient, and giving a decreased noise level.

The land lines from the receivers to the terminals require a number of repeaters to keep the signal to noise ratio large.

The gain in the transmitter is 10^8 times, the loss in the radio link about 10^{14} times and the gain in the receiver 10^7 times. The variations of received volume due to fading are slow and are taken care of by technical operators.

The transmitters are of the double balanced modulation type. The first time the speech modulates a carrier of 35 kc. producing side bands of 33,300 to 36,000 cycles and 32,700 to 30,000 cycles. Due to the fact that the modulator is of the balanced type the carrier is eliminated and then the upper side band is filtered out, leaving only the lower one. This is used to modulate another carrier of 88,500 cycles, resulting in a pair of side bands that are widely separated, extending from 118,500 to 121,200 cycles and from 58,500 to 55,800 cycles. The lower band is selected and after amplification in three stages, gives the required antenna power of 150 kilowatts.

The antenna system used is non-directional and consists of a series of parallel conductors several thousand feet long and supported on steel towers 400 feet high.

The receiving antenna is a long wave directional one, grounded at the ends through suitable impedances and connected to the receivers through transmission lines.

Short Wave Channels

There are three short wave channels in use for the New York-London service and one for the Montreal-London service. The American transmitters are at Lawrenceville, N.J., and the receivers at Netcong, N.J. This distance of about 50 miles give the minimum interference between the transmitter and the receiver. The British stations are transmitting from Rugby and receiving at Baldok. The Canadian stations transmit from Drummondville and receive at Yamachiche, Quebec.

These stations work on three channels, approximately 19,000, 14,000 and 9,000 kc., depending on the time of day. After passing through a two stage audio amplifier the speech currents modulate,

by plate modulation method, the output of two 250 watt tubes, crystal controlled. This is fed to a radio frequency amplifier which is capable of delivering 60 kw to the antenna at the peaks of the modulation cycle, with 100 per cent. modulation.

The antenna systems are highly directional. Reflectors are placed behind the antenna and a quarter of a wave length away. The use of such a system reduces the required power to produce a given signal strength in a certain direction to one eighth.

A new type of antenna, known as a Double V will give a gain of about 40 times within a frequency range of 2.5 to 1, thus covering the day, night and transition frequencies.

The receivers use double demodulation and an automatic gain control to take care of the rapid and wide swings of intensity found in short wave signals that are not found on the longer waves.

SCHOOL DINNER ADDRESS

Adapted from an address

by

J. M. R. FAIRBAIRN, D.Sc.,
CHIEF ENGINEER OF THE CANADIAN PACIFIC RAILWAY

at the 43rd Annual School Dinner, Hart House, November 29th, 1932.

It is a great pleasure and privilege to me to be with you to-night on this happy occasion.

I congratulate you most heartily on the large and enthusiastic gathering which I see before me to-night—very different in size from that to which we were accustomed in my student days.

If the influence and prestige of the old School among its fellow colleges has kept pace with its numbers, you must surely now hold an enviable place in that galaxy of faculties which goes to make up the University of Toronto.

Forty years ago the Engineering Society was making arrangements for its Annual Banquet—the ever important subject of drinks was under discussion, and brought on a heated argument as to whether we should or should not provide out of the dinner funds for the liquid refreshment of our guests of the occasion, the alternative being one not now possible—to let them order and pay for it themselves. Being of Scotch descent—and consequently of an hospitable disposition—I was impelled to take to my feet and make my maiden speech in favour of providing everything the funds would allow.

Forty years is a long time when looked forward to from your point of view, but when looked at in retrospect from mine, it is relatively short—like the memory of the Engineering Society, which has evidently forgotten or forgiven my maiden effort—because I am here to-night as the result of a fully accredited and most courteously given invitation. You have, therefore, only yourselves to blame for what you may have to listen to.

There have been made from time to time so many excellent speeches about Engineering, the work of Engineers, and kindred subjects, by men eminently qualified to speak on them, that I fear to touch on anything of that kind, and propose, therefore, to give you only a few observations on the subject of your education and its relation to the work which lies before those of you who are to follow the engineering profession—and perhaps a little advice from one who is now reaching the opposite end of an engineering career from that which you are now approaching.

Education does not make a man—his character and his ability, his ambition and the energy and initiative which he brings to bear in the attaining of it are all the outcome of Nature's own equipment. It is these qualities which determine any man's place in the field of his operations. An education, if he has one, may determine what his field of operations will be, and will help him to attain his

proper place in that field, but it is, in the final analysis, those qualities which are native in his make-up which will determine the measure of his success.

Let no young man graduating from an engineering course imagine that he is an Engineer, or that his education is complete. As long as he follows the calling of an Engineer of any kind, or an Architect, he will be adding to his education, both by his own experience and by reading the experiences of others. Apart from giving him a thorough grounding in mathematics, physics, chemistry and such subjects as invariably underlie the operations of his profession, the greatest thing his education can do is teach him where and how to look for the information he requires from day to day in connection with his work.

Many men have been successful engineers who have never seen the inside of a college, but you will almost always find these same men sending their sons to college, that they may have the advantage of an education in their participation in the struggle of life.

To those of you who are commencing a college training, I say make the most of it, and to those who are completing it and looking forward to making a start in life, I would say be prepared for hard work, hard knocks, and, at the moment, hard times.

Do not while in college make the mistake of thinking that so long as you have a degree you will be able to make the grade afterwards by reading up as you go along—make of yourselves in college regular sponges to absorb all the information available in every subject. I often think that every student should, before he enters college, have a year or two of the sort of work he hopes to take up afterwards, just to give him a thorough appreciation of the opportunities which are his when going through. While he should, and must, read—and continue to read after he is out on his own in the world—he will find it much harder to manage, and have much less time to devote to it, than when in the atmosphere of student life.

On graduation there is the all important problem—probably more acute now than for many years—of what line to attempt, and where to get a job in that line. Engineering generally has become so broken up into specialties that one must inevitably follow one of its many branches, and he is well advised who has decided early in his college career which of these many branches most interests him, and has so specialized in his studies as to be specially qualified to take up work in that branch of the profession.

When a job has been secured, that man is fortunate who finds hmself entirely suited to the work he has to do. If he does, let him stick to it—if he does not, and cannot soon suit himself to it, he should keep on changing till he locates himself properly, and then give to his job the best that's in him.

If Nature endowed him with a fair share of ability, ambition and energy, and if he has made the most of his education and his opportunity to mould his own character, he cannot fail to succeed.

But what is success? A purely relative thing, measured in the mind of every man by his own standard, and, therefore, as variable as are the minds of all of us.

A man who may be considered a great success by one group would be considered a failure, or a nobody, by another group—but is it not a man's own estimate of his success which counts? All of us in this world are looking for happiness and contentment, and when a man achieves through his own effort what he considers success, is he not happy and contented, at least for the time being, even though his ambition may later urge him on to still greater effort, and still greater success. It is here again that education comes to our aid. It, I believe, more than anything else, helps a man to realize his own limitations, and guides him in following that course in which he will probably achieve the greatest success, happiness and contentment.

THE FOUNDING OF THE ENGINEERING SOCIETY

Extract from a letter to the British Columbia Branch of the Engineering Society of the University of Toronto, from T. Kennard Thomson, '86, New York, December 24, 1930.

Mr. President and Fellow Graduates:

It is a great pleasure to receive the flattering suggestion to write you a line for your Annual Meeting.

It is fortunate that in starting anything new, the human mind fails to grasp all the difficulties in the way, for those who foresee the most obstacles (some of which never exist) accomplish nothing because they never get started.

Was it not Napoleon who said:

"*It is impossible, therefore I shall do it.*"

This is often good logic, especially in war, for if a thing is obviously impossible nobody would prepare to oppose or obstruct it.

In 1885 when I found the prevailing opinion was that our School was too young to support an Engineering Society I appeared to drop the subject and a few weeks later invited some 25 or 30 to take supper with me on Hazelton Avenue, where three of my sisters and myself were keeping house. One of my married sisters, the late Mrs. Glackmeyer, did much to help with good suggestions.

How I persuaded the boys and professors to accept my invitation I do not know, but they certainly honoured me with their attendance, although none of them had the slightest intimation of my object until after the coffee, when I got up and proposed forming the Engineering Society of the University of Toronto.

That great man, our late Dean, then Professor Galbraith, at once rose, clinched the matter, and proposed that a committee be appointed then and there to make a rough draft for the Constitution. The committee consisted, I think, of B. A. Ludgate '85, now of Pittsburgh, Pa., the late Herbert J. Bowman '85 (or was it J. F. Beakley) and myself.

We did not consider any of the students, at that time, big enough to be President of the new organization, so we persuaded Professor John Galbraith to take the helm for the first few formative years, until he thought the time ripe for the first student president, H. E. T. Haultain, 1888-89.

The officers in 1885 were: President, Professor Galbraith; Secretary, T. Kennard Thomson; 3rd Year Representative, B. A. Ludgate; 2nd Year Representative, J. R. Gordon; 1st Year Representative, J. C. Burns. And for 1885-86: President, Professor Galbraith; Vice President, (the first) E. B. Hermon, D. and P.L.S.; Secretary-Treasurer, J. C. Burns; Corresponding Secretary, T. Kennard Thomson; 3rd Year Representative, A. L. McCulloch; 2nd Year Representative, J. Rogers; 1st Year Representative, G. H. Richardson.

I have copied these names from the first volumes of our Transactions, of which I have a full set (from No. 1), bound, and treasure with pride.

As Corresponding Secretary, I had the pleasure of communicating with all of our earlier graduates and ex-students. Some of the latter should be on the permanent rolls of our School—although they never went back for their final examinations. Conspicuous in such a list would be W. F. Tye, the first I think to send us a paper, some time Chief Engineer of the C.P.R., and President of the Canadian Society of Civil Engineers, that infant Society born 1887 two years after our Society.

Tye did not feel like giving up his job on the C.P.R. to take his final year at college.

I invited all of the students of the second and third years, with Professor (later Principal and finally Dean) Galbraith; Doctor (afterwards Dean) Ellis; one of my room mates at Upper Canada College, the late James D. Thorburn, who became a brilliant doctor; William Burritt; James E. Jones (now magistrate and author), and David T. Symons, now an eminent lawyer in Toronto, all of whom had also been at U.C.C. with me.

In his speech Symons quoted "*Breathes there a man with soul so dead, who never to himself has said, this is my own, my native land,*" which was very appropriate, as it typified and still typifies the love we all have for our old "S.P.S." and our Engineering Society.

With very best of wishes for you, one and all.

(Signed) T. Kennard Thomson,
S.P.S. '86.

(*Editor's Note:* A copy of this interesting letter was sent by the writer to Professor T. R. Loudon and is published here with the gracious consent of both parties.)

ENGINEERS

1933

YEAR BOOK

OF THE

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

FACULTY OF APPLIED SCIENCE
AND ENGINEERING

UNIVERSITY OF TORONTO

ENGINEERING
SOCIETY
EXECUTIVE
Faculty of Applied
Science & Engineering
1932 U of T 1933

Elections

The elections have become a thing of the past for another year, but no one can say that he did not have his fling for one day. By the looks of some, it appeared that they were in favour of carrying over the elections till Monday but the voting was really done on Friday because, after all, that is why elections are held.

Nominations opened early Monday morning but according to an established custom the candidates thought it would be vulgar if they signed the slip before five o'clock Tuesday night.

Fortunately or unfortunately the nomination speeches were to be held on Wednesday. But as every one knows, that particular day wash Ash Wednesday. As a result all the nominees turned up to address the boys, and all the boys turned it down in favour of the Imperial or Roxy.

As in the past, everyone skipped the lecture or lab between twelve and one on election day to dine in the Great Hall. After everyone had enjoyed his fill (imagine enjoying a fill in Hart House) the bunch went down the hall to the Common Room where every song from "Colombo" to "I Love You Truly" was sung. Visitors were treated with the customary hospitality. Some were asked to remove their coats and remain for awhile and others were so welcome that they were asked to remove even more than their coats.

Following this fiesta there came the big moment in every frosh's life when he would parade down to the Little Red School House and unhesitatingly, disdainfully and with a nonchalant air, mark 1, 2, 3 after the first three names on the ballot irrespective of whether the candidate was a Mohammedan or an Eskimo, black or white. Many gave more thought to voting than they probably will to getting up their lectures. Others thought that all cares should be banished for the day and as a consequence down-town theatres had extra protection in an endeavour to prevent the Scotch element of the gang from gaining admission by the well-known imaginary pass.

In the evening, due to Doug Smith's untiring efforts, entertainment and eats were dished out with rare abandon in Hart House. At the same time interested electors saw slides without the name of their favourite son and thought that his name must have been last on the ballot.

A list of the successful candidates is given below for those who did not take part in the merry-making.

J. J. A. Howe,
Returning Officer.

Election Results

FRIDAY, MARCH 3, 1933

ENGINEERING SOCIETY

President.....C. W. TYSON
First Vice-President.....W. S. SMITH
Second Vice-President.....D. G. RITCHIE
Treasurer.....R. HEWITT
Secretary.....A. D. LEPAN

ATHLETIC ASSOCIATION

President.....H. K. C. MCNICHOL
Vice-President.....J. STAVERT
Secretary-Treasurer.....E. R. EATON
3T4 Representative.....
3T5 Representative.....R. D. WALDEN
3T6 Representative.....J. A. MCARTHUR

CLUB CHAIRMEN

Architectural Club.....F. LASSERRE
Chemical Club.....D. F. FRASER
Civil Club.....J. P. BORBEY
Debating Club.....A. C. KING
Electrical Club.....N. D. SCHELL
Mechanical Club.....D. F. CORNISH
Mining and Metallurgical Club.....J. W. CARRINGTON

PERMANENT EXECUTIVE 3T3

President.....M. J. WERRY
Vice-Presidents.....W. J. BEYNON
F. V. C. HEWETT
Secretary-Treasurer.....W. W. WESTAWAY
Councillors.....R. P. BAILEY
H. H. COOK
R. E. HAMMOND
M. A. MACKAY
M. SAUNDERS

EXECUTIVE 3T4

President.....H. L. SHEPERD
Vice-President.....H. G. HILL
Secretary-Treasurer.....G. J. JARRELL

EXECUTIVE 3T5

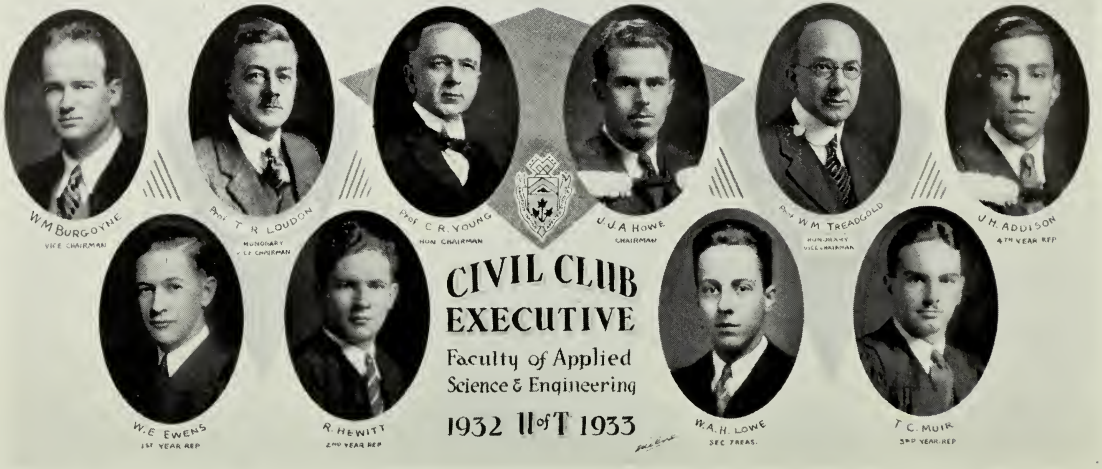
President.....N. M. Kelly
Vice-President.....J. A. C. Bowen
Secretary-Treasurer.....R. E. N. Davey

EXECUTIVE 3T6

President.....R. B. McIntyre
Vice-President.....L. B. Sharpe
Secretary-Treasurer.....G. H. Maynard

BRONZE "S"

J. R. Fitzpatrick


W.M. BURGOYNE
VICE CHAIRMAN
Prof. T. R. LOUDON
HONORARY VICE CHAIRMAN
Prof. C. R. YOUNG
HON. CHAIRMAN
J. J. A. HOWE
CHAIRMAN
Prof. W. M. TREADGOLD
HONORARY VICE CHAIRMAN
J. H. ADDISON
4TH YEAR REP.
W. E. EWENS
1ST YEAR REP.
R. HEWITT
2ND YEAR REP.
CIVIL CLUB
EXECUTIVE
Faculty of Applied
Science & Engineering
1932 II of T 1933
W. A. H. LOWE
SEC. TREAS.
T. C. MUIR
3RD YEAR REP.

Civil Club

Once again thoughts of examinations are foremost in the minds of all, and at this time of year recollections of the happenings during the past six months are made by everyone. One recalls the happy gathering at the School Dinner, the enjoyment of School Nite and the hilarity of the School At-Home. While thus reminiscing, it would be well to review the activities of the Civil Club.

Although the official trips of the various clubs were banned this year by the faculty, permission was obtained for members of the third and fourth years to have an excursion. Accordingly, one bright morning in autumn about twenty men motored to the Border Cities and Detroit to inspect the Ambassador Bridge and the Detroit Tunnel. Much information concerning both undertakings was obtained from the guides, and the interest shown by members of the club proved conclusively that such jaunts were not just a waste of time. Most of the boys remained over until Sunday to enjoy the hospitality of the populace. But a few considered the trip as a whole to be unsuccessful.

Around the latter part of November a smoker was held in Hart House and considering various circumstances a good crowd was present. A precedent was established as there was no speaker and thus the boys had an opportunity of becoming thoroughly acquainted. This proved a great asset to the first year men. Moving pictures were shown of various projects and at the conclusion of the meeting Professor Treadgold gave a brief talk. Incidentally, it is suggested that several such gatherings be held throughout the year in the future.

On March 7th the annual dinner was held at the Engineer's Club, and although it was not the largest in history, nevertheless it was highly successful. The speaker for the occasion was Col. C. S. L. Hertzberg who gave an enlightening address on "The Requirements of a Successful Engineer". The humour which was intermingled with sound advice was appreciated by both professors and students.

And now that the elections are over the reins of office fall to John Borbey. It is felt that they are in capable hands, and needless to say, success will attend the Civil Club during the coming year.

In conclusion, thanks is extended to the professors and executive who so unselfishly worked to make the activities of the club a success.

J. J. A. Howe,
Chairman.

FOURTH YEAR CIVILS

Back Row: W. R. McColl, P. J. Howe, F. A. Bryan, G. W. Lawson, L. R. Ord, J. M. Jordan, J. Playfair, M. A. Elson, M. R. Lemon, C. B. Britnell.

Front Row: E. C. Lyons, T. W. Wilson, J. J. A. Howe, Prof. C. R. Young, Prof. W. J. Smither, M. S. Saunders, J. K. McBride, J. H. Addison.

FOURTH YEAR MINERS AND METALLURGISTS

Back Row: Prof. I. T. King, Prof. F. C. Dyer, T. C. Wheatley, W. A. M. Hewer, L. F. Gauvreau, F. A. Fell, J. M. Thompson, J. J. Enlow, Mr. H. L. McLelland.
Middle Row: W. W. Westaway, J. M. F. Gillis, J. A. Bell, Mr. S. E. Wolfe, E. J. How.
Front Row: Prof. H. E. T. Haultain, F. V. C. Hewett, Prof. G. A. Guess, J. E. Hilder, H. C. Herz, J. N. Botsford, B. M. Arnott, S. S. W. Cole.

J. N. BUTSFORD
4TH YEAR REP.
G. C. BATEMAN
F. C. WHEATLEY
MINING
AND
METALLURGICAL CLUB
EXECUTIVE
Faculty of Applied Science & Engineering
1932 U of T 1933
R. B. CODE
3RD YEAR REP.
J. G. FARRAR
2ND YEAR REP.
W. V. DUTTON
1ST YEAR REP.

The Mining and Metallurgical Club

A most successful year of interesting activities and pleasurable events was experienced by the Club.

"The Proving and Enlightening of Sweet Innocence" sums up the hilarious reception to the freshmen, capably and admirably carried out by the sturdy men of second year.

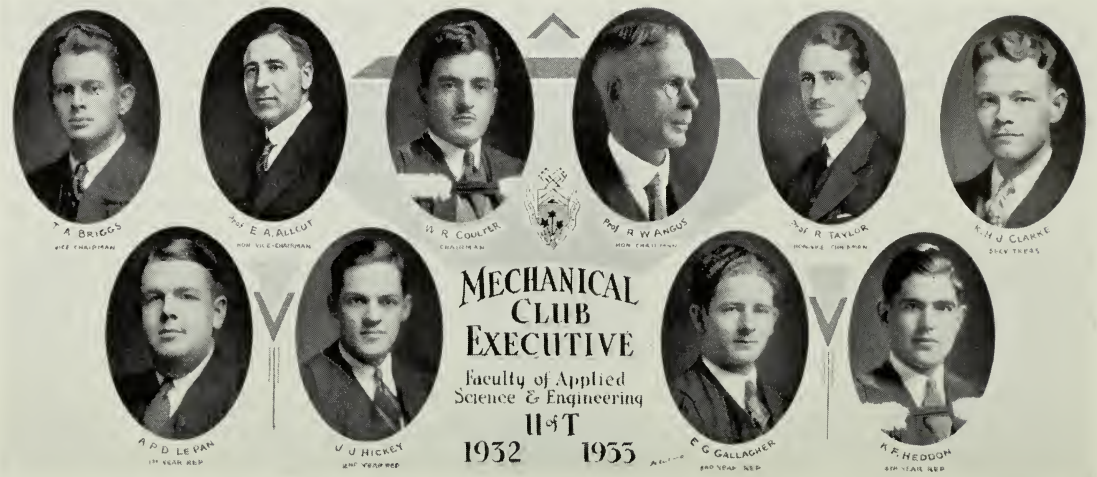
A good turn-out on a stormy night attended the first Club dinner to hear a fine discourse on "Silicosis" by our Honorary Chairman, Mr. G. C. Bateman, Secretary of the Ontario Mining Association. The second dinner evening was attended by the largest gathering in recent years. Mr. J. Y. Murdock, President of Noranda, gave a fascinating talk on "Noranda, and Its Early Days." At the final dinner, Mr. Fraser Reid general manager of Howey Gold Mines, delivered an interesting address before a large group on "Low Costs at Howey." An added feature on that occasion was the presentation made to Professor Haultain by the students, marking the twenty-fifth year of his official connection with the Department of Mining Engineering and the University.

The social side of the Club's activities was well looked after by two functions. The first was the annual tea-dance kindly given to the Club members by the Association of Women of the Mining Industry. Numerous leaders in the mining game were present, including the Hon. Chas. McCrae, Minister of Mines for Ontario. The second function was an informal supper dance held at the Savarin Restaurant. This was a new departure for the Club and it was thoroughly enjoyed.

This year the Club has upheld its active and vigorous record of the past. Credit is due to the student members for their loyal support and to the executive for their work and co-operation. Particularly is credit due Mr. Bateman, who was unstinting of time and interest in his paternal guidance of Club affairs. All dinners were held at the Engineer's Club, whose facilities were kindly made available to us. At each dinner a number of down-town mining men were present who contributed largely to the interest of those functions.

Hearty good wishes are extended to Johnny Carrington, the chairman-elect, and his new executive for the coming year.

F. V. C. Hewett,
Chairman.


T A BRIGGS
VICE CHAIRMAN
Prof E A ALLCUT
HON VICE-CHAIRMAN
W R COULTER
CHAIRMAN
Prof A W ANGUS
HON TREASURER
Prof R TAYLOR
HONARY CHAIRMAN
N H J CLARKE
SECY TREAS
A P D LE PAN
1ST YEAR REP
V J HICKEY
2ND YEAR REP
MECHANICAL
CLUB
EXECUTIVE
Faculty of Applied
Science & Engineering
U of T
1932 1933
E G GALLAGHER
3RD YEAR REP
K F HEDDON
4TH YEAR REP

Mechanical Club

Five years ago the Mechanical Club had its beginning as a separate club of the undergraduate Mechanical Engineers of the University of Toronto. Its purpose is and has been to foster social and intellectual comradeship between all the mechanical engineering students, and to give them a chance to hear of some of the problems and activities of men engaged in their chosen profession.

One of the special features of the club's yearly activities, namely, the annual trip to some out of town factories, was not permitted this year. However the fourth year Mechanicals along with some of the Electricals visited the power generating plants at Niagara Falls and spent an interesting and enlightening day inspecting these vast hydraulic and electrical developments.

The real activities of the club for the year 1932-33 began with a smoker at Hart House in November. At this smoker something new and different in the way of speakers was tried out. Two members of the fourth year speaking on their theses, gave the members of the junior years a chance to see and hear just how much these seniors did or did not know. Refreshments and smokes were of course distributed to all present.

Just before Christmas something lighter in the way of entertainment was provided by a Mechanical Club Supper Dance at the Embassy, when many of the potential engineers made merry with dancing and eating as only engineers can.

February 1, 1933, marked the date of the Mechanical Club Annual Dinner, the place, the Engineer's Club. Mr. F. W. Paulin of Hamilton, a school graduate of '07, was the guest speaker, and although he spoke only for a few minutes he packed plenty into the few words that he did say. Previous to the speech Mr. Giordemaine "Toronto's gay magician" entertained the diners with his clever tricks and snappy talk.

Early in March the Club held another smoker, this time engaging an outside speaker.

Although the Club's activities were limited somewhat by the shortage of funds, a fact which unfortunately is rather prevalent in everything this year, it is felt that the Mechanical Club this year, as ever before, was one of the best Engineering Clubs at the Little Red School House.

W. R. Coulter,
Chairman.

FOURTH YEAR MECHANICALS

Back Row: T. R. Sykes, A. E. Salter, A. L. Scott, F. G. Scrimgeour, W. J. Henderson.
Fifth Row: J. A. Buck, J. A. C. Armstrong, G. F. Fry, F. R. Charles, F. W. Gilroy, K. G. Mitchel, S. Tenenbaum, E. S. Jewett, W. B. P. Brown, J. R. Fitzpatrick, F. R. Ross.
Fourth Row: K. F. Heddon, W. B. Lawrence, C. D. Long, T. F. Taylor, F. M. Johnson, R. P. Ritchie, J. R. Beale.
Third Row: M. Mottish, O. A. Klein, F. J. Billett, J. S. Green, A. D. Iredale, H. H. Cook, C. G. Gibson, E. A. Mabee, A. Robertson, F. J. Stubbs, J. H. Cairns.
Second Row: K. L. Morris, W. D. Smith, M. McKillop, Professor Allcut, Professor Angus, Professor Taylor, Professor McIntosh, J. S. Ball, J. R. Renwick, C. E. B. Bedford-Jones.
Front Row: W. R. Coulter, C. J. Bullick, F. H. Cowan, G. W. Wilson, S. E. Swallow, D. D. Pana

FOURTH YEAR ELECTRICALS

Fourth Row: J. S. Ball, C. G. Dickson, C. F. Howden, P. R. McAdam, T. W. Darcy, O. L. Britney, J. C. R. Punchard, G. R. Grass, R. E. Chapman, L. B. Jones, J. T. Truman.

Third Row: A. W. Moffat, E. G. Drewry, M. J. Werry, G. S. Light, D. G. Gerry, W. E. Goforth, J. H. Byrne, C. E. Booth, D. H. Cargill, H. F. Tincombe.

Second Row: J. A. McCoombs, J. H. Pickett, C. J. Bridgland, M. A. MacKay, R. E. Hammond, D. M. Lovatt, W. E. Fenn, E. M. T. Douglas, A. W. M. Carmichael, D. W. W. Smillie, D. C. Gow, D. Strachan.

Front Row: Prof. T. R. Rosebrugh, Assis't Prof. V. G. Smith, Prof. H. W. Price, Mr. R. J. Brown, Mr. de F. Bayly, Mr. M. Ward, Assoc. Prof. A. R. Zimmer.

W. W. FARQUHAR
VICE CHAIRMAN
Prof. A. R. ZIMMER
HON. CHAIRMAN
M. A. MAC KAY
CHAIRMAN
B. H. LARUE
SECRETARY-TREASURER
K. E. HAMMOND
4TH YEAR REP.
N. D. SCHELL
3RD YEAR REP.
C. G. LEVY
2ND YEAR REP.
J. S. FERGUSSON
1ST YEAR REP.
ELECTRICAL
CLUB
EXECUTIVE
Faculty of Applied
Science and Engineering
1932 U of T 1933

The Electrical Club

The year 1932-33 is almost over and for some it means that "au revoir" must soon be said to many acquaintances and real friendships that have been cemented by the grind of our short years in S.P.S. Those graduating will take with them many happy recollections, among the foremost of which will be those connected with the affairs of the Electrical Club. To those who still look forward to at least another year here, we wish the very best of luck both for themselves and for the Electrical Club.

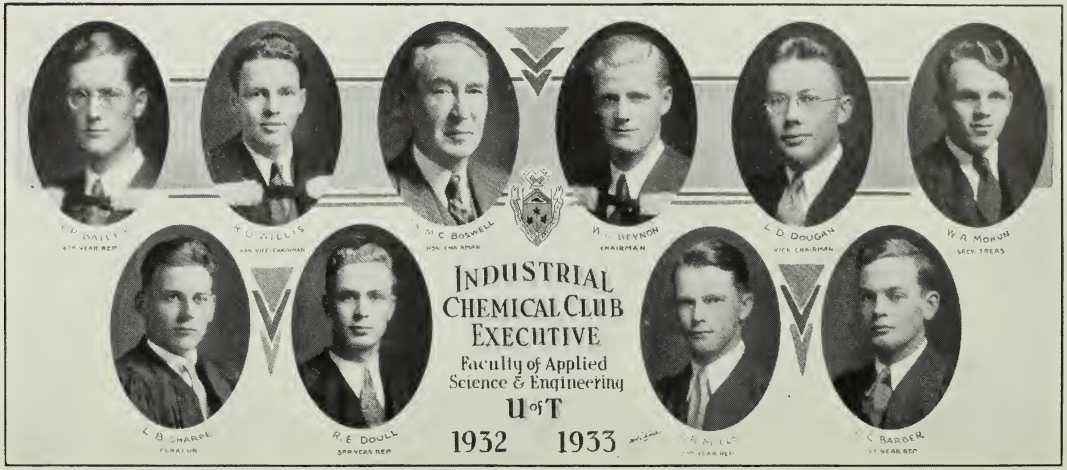
Many thanks are due to those on the executive who co-operated so willingly in order to make this year's affairs a success. As the annual trips were abolished, the club arranged an informal party for its members and their "ladies fair" at Ellen Bradley's, in order to give the boys a break into the social whirl (since they couldn't go to Hamilton or Buffalo). The fourth year men enjoyed a sight-seeing trip to the power plants of the Hydro-Electric Co. at Niagara Falls, where water falls to depths unseen and voltage rises to heights untouchable. It is only right that mention be made of "seeing the largest generators in the world" in action at the American Power Plant. Needless to say, no cigarettes were brought across the border. The height of disappointment was claimed by Ernie Hammond who took ten exposures on a camera with no film in it.

At the first meeting of the club in December, a very interesting talk on "Some Aspects of Communication Engineering" was given by Mr. B. de F. Bayly of the Radio Department of School, in his own inimitable manner. In January, Mr. J. E. Bateman of the Canadian General Electric gave an "illuminating" and well illustrated lecture on the "Manufacture and Use of Lamps in Industry".

For the first time since its inauguration, the club had a dinner which was held in the Toronto Engineer's Club, and at which Col. W. A. Steel of the Canadian Radio Broadcasting Commission gave a fine address on "The International Conference and Its Problems". This affair proved very successful and enjoyable, and we hope it may be continued in the future. About 100 were present and were "tickled pink" with the speaker, the bang-up dinner at depression prices and the free cigarettes—what more could one ask for!

We congratulate Newton Schell on being elected chairman of the club for the coming year, and with the same hearty co-operation as the present chairman has received, everything will go along smoothly.

M. A. MacKay,
Chairman.


E. D. BAILEY
4TH YEAR REP.
F. U. WILLIS
HON. VICE-CHAIRMAN
A. M. C. BOSWELL
HON. CHAIRMAN
W. J. BEYNON
CHAIRMAN
L. D. DOUGAN
VICE CHAIRMAN
W. A. MORUN
SECY.-TREAS.
L. B. SHARPE
R. E. DOULL
3RD YEAR REP.
J. R. NELLES
2ND YEAR REP.
F. C. BARBER
1ST YEAR REP.
INDUSTRIAL
CHEMICAL CLUB
EXECUTIVE
Faculty of Applied
Science & Engineering
U of T
1932 1933

The Industrial Chemical Club

Fortunately the activities this year, although few, are worthy of considerable comment. The annual excursion, a pleasure of by-gone days, was abolished, possibly because it was too much of a pleasure. The fourth year, however, enjoying their prerogative, made three interesting trips to Hamilton, Windsor and Merritton. These of course were purely instructive.

The smoker held last fall was addressed by Mr. Howard Coulter, a recent graduate in Chemistry, of the Coulter Copper and Brass Co. The trials and tribulations of the engineer encountered in electroplating commercial articles were very well outlined by Mr. Coulter and the many ingenious methods of overcoming them were exceedingly interesting.

The Christmas dinner this year was held at the Engineers' Club. Mr. G. C. McEwen of the Imperial Varnish and Colour Co. pointed out many things in the make-up of an engineer essential for success. Dr. Boswell in a philosophical strain introduced us to the "Old Professor" a personality long to be remembered by those fortunate enough to meet him through Dr. Boswell. As was very appropriately said that evening, "Let us have business and phylosophy."

The genial bartenders, under the sign of "The Pig and Whistle," in evidence at School Nite, were a joy to behold, and their "drinks" delighted everyone.

Then the Club, in seeking other entertainment, set a precedent which might well be followed in the future. I refer, of course, to the very enjoyable evening spent at the Embassy.

At the final dinner held on March 22, at the Engineers' Club, Mr. J. C. Elliot, of A. E. Ames and Co. explained some of the perplexities of our financial system.

The thought of examinations brings the hope that the Club next fall will see all its members in their proper year eager to support Don Fraser and his executive.

W. J. Beynon,
Chairman.

FOURTH YEAR CHEMICALS

Back Row: M. E. Reiner, N. R. Fasken, F. A. Edmonds, F. B. Conron, W. D. Brittain, H. F. Wheaton, N. J. Paterson, A. G. Rogers, J. Birnbaum, W. H. Palm.

Third Row: L. J. Lichty, M. Lawrence, G. R. McMillin, G. F. Brant, C. A. Osborne, L. Rabinowitch, R. K. P. Johnson, A. C. West, R. P. Bailey, A. R. Fraser, J. B. Wallace, H. M. Campbell.

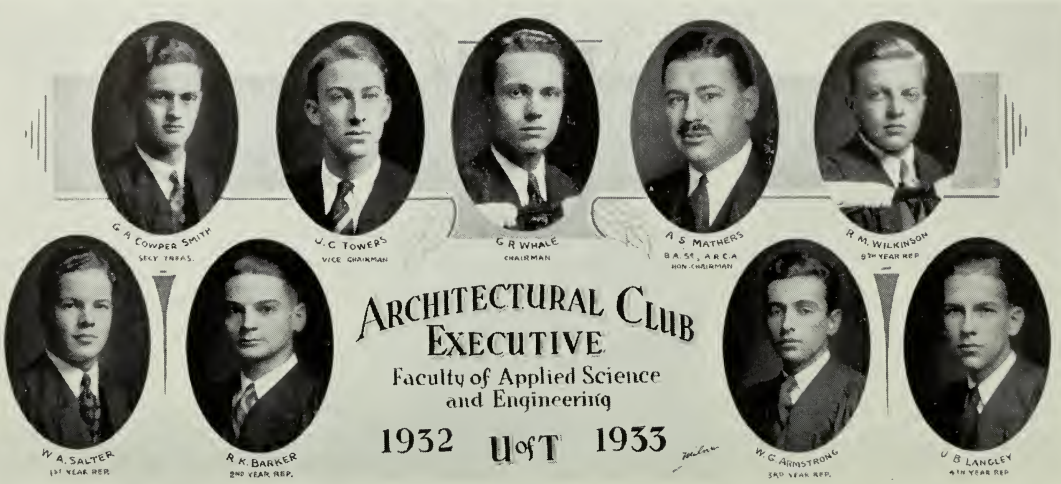
Second Row: D. F. Nasmith, D. S. Milligan, R. B. Symons, Y. L. Wong, L. E. Burrill, H. L. Bayley, H. M. Jones, F. L. White, W. E. Cowie.

Front Row: Dr. R. R. McLaughlin, Prof. E. A. Smith, E. A. Smith, Dr. M. C. Boswell, Prof. J. W. Bain, Prof. E. G. R. Ardagh, W. J. Bevnon

FIFTH YEAR ARCHITECTS

Back Row: H. H. Roberts, Mr. M. Waters, Prof. E. R. Arthur, Prof. H. H. Madill.

Front Row: R. M. Wilkinson, J. I. Rempel, M. M. Pulver, Prof. C. H. C. Wright, G. R. Whale, W. G. Quantz.


G. A. COWPER SMITH
SECY TREAS.
J. C. TOWERS
VICE CHAIRMAN
G. R. WHALE
CHAIRMAN
A. S. MATHERS
B.A.Sc., A.R.C.A.
HON. CHAIRMAN
R. M. WILKINSON
5TH YEAR REP.
W. A. SALTER
1ST YEAR REP.
R. K. BARKER
2ND YEAR REP.
ARCHITECTURAL CLUB
EXECUTIVE
Faculty of Applied Science
and Engineering
1932 U of T 1933
W. G. ARMSTRONG
3RD YEAR REP.
U. B. LANGLEY
4TH YEAR REP.

The Architectural Club

Though strictly not a function of the club, I feel that the sketching trip to Gull Lake and its results should be mentioned here.

This trip starts the year for those in architecture with the exception of the freshmen. The weather at Gull Lake this fall was particularly bad for outdoor work, but even so the best results that have been produced by the students were brought forward this year. An exhibition of their work was held in the Engineering Building in October and was very largely attended by an appreciative crowd.

The opening meeting of the club was in the form of a dinner at the Royal York. Mr. A. S. Mathers, our honorary chairman, gave a talk on the existing conditions of architectural design. The Freshmen and Freshette were formally introduced to the older members of the club and put things over with a bang in their several skits.

In December Mr. John M. Lyle gave us a very interesting address indeed, on Canadian decoration and details which he has designed and used on his many buildings.

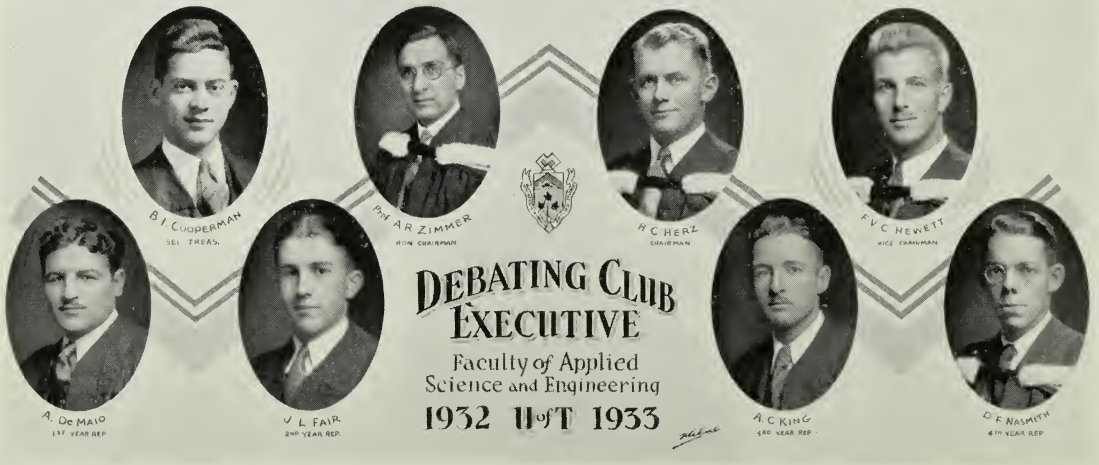
On February 15th the club held forth at the Grange during the Biennial Exhibition of the Toronto Chapter of the Ontario Association of Architects. On this night a feature was made of student work of the School of Architecture. A goodly number of drawings were hung and a large crowd attended the exhibition.

Now comes the nite of nites—the club party—that something which everyone was waiting for—except one member of the Fifth Year. The dance was held in the Malloney Art Gallery and everyone enjoyed themselves thoroughly. Something new was started this year in having a floor show which proved to be a big success, and as I understand it, next year's party will see the best floor show on the continent sponsored by one of the "staff". The Chin-dig proved too much for a couple of the members, who left early to spend the rest of the wee hours by the "fireside".

The annual School Election was held March 3, and as the "old order changeth yielding place to new," we have a new and very promising Club Chairman. Fred Lasserre, gentlemen, is full of wim, wigor and witality. He has some ideas and "Ideals" which, with a good executive and the co-operation of all members of the club, I am sure he will put across successfully.

Here's wishing you all possible success Fred during 1933-34 as chairman. Oh yes, I hope that the graduating year has the good wishes of all undergrads now that they are being turned out into the cruel, cold world. They'll need them fellows, they'll need them.

G. R. Whale,
Chairman.


B I COOPERMAN
SEC. TREAS.
Prof A R ZIMMER
HON. CHAIRMAN
H C HERZ
CHAIRMAN
F V C HEWETT
VICE CHAIRMAN
A. DeMAIO
1ST. YEAR REP.
V L FAIR
2ND YEAR REP.
A C KING
3RD YEAR REP.
D F NASMITH
4TH YEAR REP.
DEBATING CLUB
EXECUTIVE
Faculty of Applied
Science and Engineering
1932 U of T 1933

The Debating Club

The past year has seen another chapter in the bitter struggle of this club against School's innate aversion to public speaking. It is a profound characteristic of an Engineer to take amazing pains to avoid, if possible, speaking "on his feet." To combat this situation, to afford men of S.P.S. the opportunity needed and to silence the voices of regret in this connection after graduation, are the primary aims of this Club.

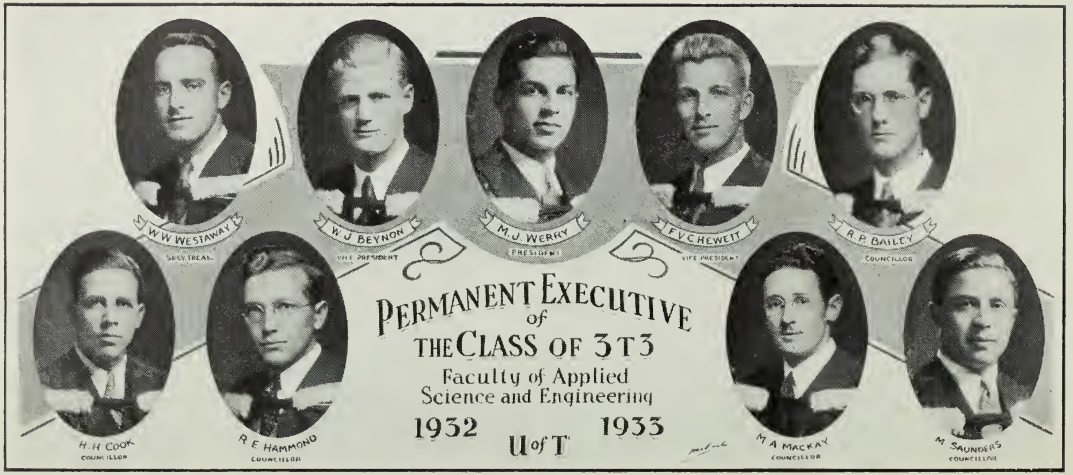
We have concluded an interesting year. Discussions during the season covered the pros and cons of a variety of topics such as "Initiations," "A New Political Party," "Machinery and Unemployment," and others. The Inter-year Debates were very closely contested. In the opening one First Year was vanquished by Second in a valiant effort to maintain "Machinery, as the chief cause of Unemployment." The losing year was ably represented by Globe and Johnstone, and the winners were Johnson and Sinclair of Second Year. In Third and Fourth Year Cooperman and Bickford unsuccessfully contended "That Highway Transport should be controlled by the Government to protect the Railroads," falling beneath the onslaught of Panabaker and Taylor of the senior year. The Finals then constituted a hard battle between Second and Fourth, represented by Johnson and Bowen and Panabaker and Taylor, respectively. The issue under debate was in this case "That Section Ninety-Eight of the Canadian Criminal Code should be Repealed." After a very warm discussion, the decision, and Segsworth Trophy were awarded to the Fourth Year arguing for the affirmative. The Oratorical Contest followed soon after, and out of twenty-three entries, all of them of no mean excellence, the prizes finally went to three men of first year. Hoag spoke with rare parliamentary fervour on "Free Trade and Prosperity," receiving first award,—Irvin, second, with a philosophical treatment of "My Conception of the Universe" and Robb, third, with a very witty explanation of "Why the Ocean was built so close to the Shore."

The final wind-up was in the form of a successful dinner in the Faculty Union, Hart House. The speaker, Mr. Aubrey Bond, K.C., gave us an excellent example of what can be done in oratory in an interesting speech on "The Kingdom of America,"—involving a comprehensive story of the political growth of Canada to its present status in the British Empire.

In closing, the Club executive wishes to express its sincere gratitude to Professor Zimmer, the honorary chairman this year, and to Professors Wright, Allcut and Mackintosh, and to all those students who have participated, for their invaluable interest and support evidenced in the activities of the Club this year.

In welcoming next year's chairman, we extend to "Red" King a hearty wish for a successful year of arguments in 1933-34.

H. C. Herz,
Chairman.


W.W. WESTAWAY
SEC'Y-TREAS.
W.J. BEYNON
VICE PRESIDENT
M.J. WERRY
PRESIDENT
F.V.C. HEWETT
VICE PRESIDENT
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COUNCILLOR
H.H. COOK
COUNCILLOR
R.E. HAMMOND
COUNCILLOR
M.A. MACKAY
COUNCILLOR
M. SAUNDERS
COUNCILLOR
PERMANENT EXECUTIVE
of
THE CLASS OF 3T3
Faculty of Applied
Science and Engineering
1932 U of T 1933

Message Of The Permanent Executive, 3T3

Four years ago, there entered this institution two hundred-odd fellows, practically all of whom were intent on becoming engineers. Four years have had quite an effect on them: they are older, more mature in thought and action and with many of their youthful ideas blown away. Some of them are still hopeful of becoming successful engineers, others hope to enter business, while others are not quite sure what they are going to do.

We have added several outstanding chapters to the old book of School Traditions, our Soph-Frosh Banquet, the Burwash Raid, the initiations that we administered, as well as other numerous items of a scholastic, social and athletic nature.

And now we are on the last lap of our undergraduate career. In a very short time our college days will be a thing of the past. We will be separated just as quickly as we were brought together that September day four years ago.

To prevent this separation from being too complete you have elected your Permanent Executive, whose main duty will be to hold the class together in the years to come.

To do this we are going to need your help. Be sure to let us know what you are doing, and if anyone gets married we want to hear about that too. Wonder who will be the first one to get married after graduation? Or whose will be the first to receive the title of "3T3 Junior". Wonder if in another twenty-one years there will be any McKillop Jrs. floating around in the drafting room, or any "Stew" Ball Jrs. scabbing on laboratory reports? Well, time will tell!

And in closing, gentlemen, let me remind you that you will be hearing from your Executive very shortly, and when you do—how about some hearty co-operation?

M. J. Werry,
President.

217 Delatre St.,
Woodstock, Ont.

W. W. Westaway,
Secretary-Treasurer.

153 Sherman Ave. S.,
Hamilton, Ont.

C. H. ADDISON
CIVIL REP
M. J. WERRY
SEC'Y TREAS
W. D. SMITH
PRESIDENT
DEAN MITCHELL
HON. PRESIDENT
C. V. BRIGGLAND
VICE PRES.
R. N. [illegible]
MINING REP
A. F. HEDDON
MECHANICAL REP
R. M. WILKINSON
ARCHITECTURAL REP
FOURTH YEAR
EXECUTIVE
Faculty of Applied
Science & Engineering
1932 U of T 1933
R. P. BAILEY
CHEMICAL REP.
R. E. HAMMOND
ELECTRICAL REP

3T3

Each year at the time Transactions comes off the press there is a prevailing atmosphere of tension and apprehension around School. It has become a matter of days before the professors get out their carefully sharpened axes for the annual slaughter.

The feelings of 3T3, as they approach the exams for what they hope will be the last time, are rather conflicting this year. Beyond the smoke of the examinations, there can be seen by the anxious, searching eyes of the graduating year little from which to gather comfort and much to cause consternation. But in spite of the forbidding aspect ahead, I can safely say that there isn't a man in fourth year who isn't at this time more or less eager to be out and at it, come what may.

We have spent four glorious years here. Years which we shall perhaps enjoy more in the future with their wealth of reminiscences than we did at the time. However, four years are plenty. School routine loses its glamour, and so almost eagerly, in spite of the uncertainty ahead, 3T3 goes out with the same spirit that has carried it with distinction through School, to enter the next stage of our education, which is life.

In closing let us wish every success to the years following. Let them see to it that School traditions be not allowed to die too easily if at all.

Wm. Douglas Smith,
President.

3T4

Last September the class of '34 entered upon a year which has been the busiest in its undergraduate life to date. Innumerable lab reports, athletics, and social events have kept us moving at a break-neck pace.

In studies and lab work some have doubtless excelled and some may not be so lucky but that is a matter for higher minds than ours to decide. Athletics have also kept a large number of third year men from suffering too much from rheumatism and approaching old age. But, since these are written of elsewhere in this book, we will pass on to two events which are paramount in the year's activities.

On November 22nd, we invaded the Embassy for our Fall Year Party and even such important matters as adiabatic expansion curves and hydraulic grade lines were forgotten. One hundred and fifty would-be engineers, with their respective "one-and-onlys" made the welkin ring with "sounds of revelry by night". Some of the boys, however, were seen experimenting, during the evening, upon the trajectory of a jet of water. The apparatus used was a tricky little instrument known to laymen as a water-gun. The orchestra leader is said to be looking yet for the young experimenter who quite thoroughly soaked the back of the former's neck.

The second outstanding event of the year was the Junior-Sophmore Funfrolic on the night of January 27th. This time the scene was shifted to the Crystal Ball Room of the King Edward Hotel. There, Juniors and Sophmores joined forces to stage a combined party which is still remembered by countless co-eds.

It is with regret that the present executive lays down its duties. But we know that in Lawrence Shepherd, Bunny Hill and Gord. Jarrell, 3T4 has three good men who will carry on to make next year bigger and better. We are looking forward to it—good luck to them.

W. M. Kellet
President.

3T5

It cannot be said that this year was our most successful actively, but financially it has been exceptional.

At the first of the year, the 3T5 Freshman Executive handed over the grand total of one hundred and eighty dollars. Of this one hundred was invested in a bond. The intention is to put this money aside for 3T5's fourth year.

The Year then had the pleasure of being entertained by the Freshmen, and once more the Banquet Hall of the Royal York was the scene of the festivity.

Again, just before the holidays, 3T5 pulled the Roof Garden apart in another orgy of terpsichorean activity. Thus the first term passed.

The second session started with the inevitable examinations, but once through these we breathed a sigh of relief, and prepared to make merry at our second Year Party. This dance was held along with 3T4. The two years combined to make it a success, and although there was no damage done, the King Edward Hotel staff must have been thankful when the party was over.

The activities of 3T5 in sport are too numerous to mention and one only needs to refer to the sporting section of this publication to see that we are well represented in all athletics.

Now to sum up, it must be admitted that the year 1932-3 might have been much better, and there is no doubt that there will be a decided improvement under the new executive headed by Nels Kelly. So we hand over the reins (plus eighty dollars reserved by careful budgeting) with the consoling knowledge that it is impossible to please everybody.

This has not been written with the usual intention of soft-soaping the Year's activities to a close, but rather to appeal to 3T5 to snap out of its lethargy and get some real School spirit.

Good luck.

D. G. Ritchie,
President.

3T6

We arrived at School on September 26, and thereafter things started to happen in a hurry. (Upper years take time out to laugh.) But beyond this peculiar coincidence, the strange part is that they started to happen to us—and how! The second morning, we discovered that you can travel very swiftly down-stairs indeed, and that the effect of a collision between two bodies after reaching the bottom was considerable. On that day, some members of our noble band distinguished themselves by the discovery that all the water in S.P.S. was not used for the study of hydraulics.

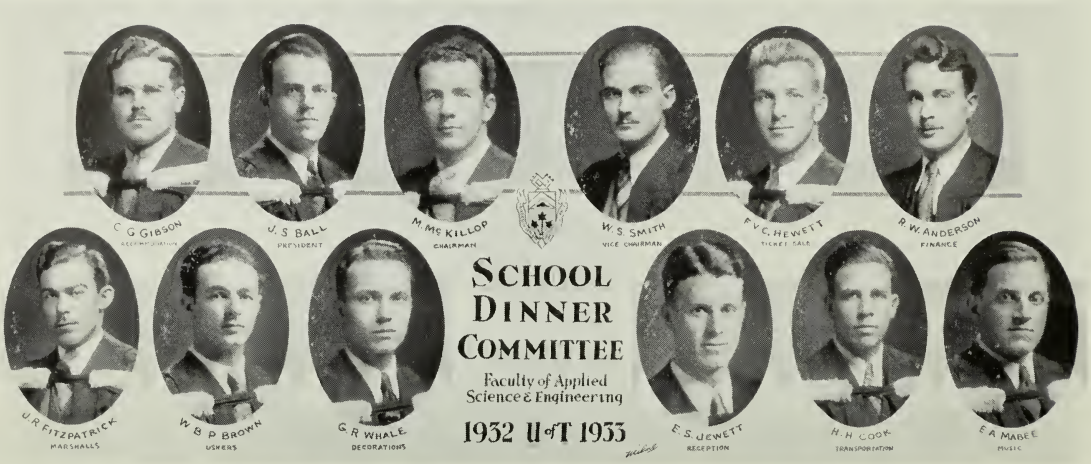
Following the "initiation", which we shall skip over as hurriedly as possible, we had an opportunity of renewing recently made "contacts" with the Sophs, under conditions where we were able to see what was about to happen before it did, when we entertained the second year at the Soph-Frosh Dance. Some four hundred and fifty couples, composed of Schoolmen and their guests, thronged the Royal York Banquet Hall. The guests departed, the dawn came, and the Royal York was still standing, thus proving that the contractors did a good job.

Gladly receiving and utilizing the break offered by the holidays, we once again returned to the prosaic grind of borrowing and lending lecture notes, and other matters attendant upon higher education. Once again those happy feet started to burn, and a party was arranged at the Slipper. The feature of this evening was the impromptu mouthing of a Toike Oike over a Canadian network, generously, if unknowingly provided by General Motors, for the hockey broadcast. Later in the evening, those school songs best adapted to such an occasion were perpetrated on an unsuspecting public over a specially arranged broadcast.

Throughout the year, we have had a large representation and a good one in the athletic activities of the University. Without singling out anyone for special mention, we can say of all that played on the various Junior School and Varsity teams, and they were many in number, that they all played the game well, and were a credit to S.P.S. in general, and in particular to 3T6.

The climax of the year's activities has just passed, with the so-called Spring Gambol in the Roof Garden of the Royal York. Novel programmes in the form of a lab. reports, a nicely balanced floor show, and punch, which, believe it or not, could be drunk with enjoyment, all were factors contributing to the evening's success. And now with the elections just passed and leaving behind a mass of blotters sufficient to absorb all the water in Hart House pool, we enter the "last long mile". Financially, the affairs of 3T6 are in good condition, and the retiring executive in handing over the reigns to MacIntyre, Sharpe, Maynard, *et al*, have every confidence that they will carry on and further the work that has been done in the past year.

Wyatt C. Irvin,
President.


C. G. GIBSON
J. S. BALL
PRESIDENT
M. McKILLOP
CHAIRMAN
W. S. SMITH
VICE CHAIRMAN
F. V. C. HEWETT
TICKET SALE
R. W. ANDERSON
FINANCE
SCHOOL
DINNER
COMMITTEE
Faculty of Applied
Science & Engineering
1932 U of T 1933
J. R. FITZPATRICK
MARSHALLS
W. B. P. BROWN
USHERS
G. R. WHALE
DECORATIONS
E. S. JEWETT
RECEPTION
H. H. COOK
TRANSPORTATION
E. A. MABEE
MUSIC

School Dinner

School Dinner with all its traditional glamour has come and gone. In order to understand the amount of work necessary to put an affair of this magnitude over successfully it is only necessary to be in the vicinity of the Engineering Society one week previous. There may be seen a hive of industry. Elaborate sign making, frantic calls at the telephone for some delayed merchandise, last minute meetings, and so on. Everyone seems very busy and when the Dinner actually begins, then the real worry begins.

It is always difficult for the committee to really please everybody and that is why we have a great responsibility cast upon our shoulders. We were successful this year in pleasing the majority since we were fortunate enough in securing Dr. J. M. R. Fairbairn as our guest speaker. There is no doubt that everyone was favourably impressed. To the few upon whose ears the words of wisdom were wasted, was provided a most outstanding array of personages at the head table.

Sir William Mulock, Sir Robert Falconer, President Cody, Dr. Bruce MacDonald and the Dean were in themselves both personally and mentally an attraction for anyone.

With such an illustrious group our Dinner was bound to be a success. To these gentlemen, therefore, we convey our thanks. To those younger gentlemen whose untiring efforts and ingenious schemes produced such an attractive programme and a well decorated hall, we also forward our sincere thanks.

If we of the Dinner Committee have succeeded, we are pleased. If you who take over our duties compliment us by keeping up a standard which we have tried to set, we will be doubly rewarded for our efforts.

M. McKillop,
Chairman.

Graduation Party 3T3

"Day and Night, It was the One." From the opening to the final strains of the syncopating orchestra it was "the" party of the the year. It eclipsed by far the At-Home, Hart House Masquerade, and other such secondary parties which have been mis-named the smartest dances of the social season.

Never before has a group of men become so elated as when it was announced that the party would continue till four. Good spirits had been in evidence during the whole evening but when this surprise was unfolded the spirits rose to inestimable heights. (Ask the elevator man.)

We are still wondering who that handsome, dashing Mexican was who provided such a thrill for the girls after supper, and also how he can break targets without even firing his cannon. He certainly had us buffaloed to say the least.

K. L. MORRIS
FINANCE

W. W. WESTAWAY
MUSIC

M. Mc KILLOP
CHAIRMAN

U. S. BALL
PRESIDENT

W. S. SMITH
GUESTS

F. R. ROSS
ARRANGEMENTS

SCHOOL AT-HOME COMMITTEE

Faculty of Applied Science and Engineering

1932 U of T 1933

How those Miners certainly turned out in a body in their soup-and-fish uniforms with their fair damsels to partake of the fun and refreshment of the evening!—What will that girl in the home-town think if she hears that her one-and-only in department one is getting to be quite the man-about-town? Also what happened to Johnny Fitzpatrick that he allowed someone to beat him in the dash behind the baby-carriages? It looks as if Fitz needs practice.

The orchestra needs no introduction and we certainly agree that they provided sweet music from their opening number to "The King" to say nothing of the Memory dance recalling each of our years and the Medley. But from under what table did they drag their illustrious leader who charmed the dancers with his gyrations without measuring his length on the floor while one of the handsome door men carried out terpsichorean fantasies on, or near, the dance floor with the said leader's girl friend.

As for crooners we had the remarkable talent of Menus McKillop who rendered in his inimitable fashion our theme song, "Brother, Can You Spare a Dime."

As has been said, this was the party of the year, as is only fitting for the final School dance of the graduates of 3T3.

School At-Home

Early in February of the year nineteen hundred and thirty-three, to be exact the eighth instant, there was held on the Convention Floor of the Royal York Hotel, the one and only School At-Home.

We were particularly fortunate in having Mrs. C. H. Mitchell, Mrs. C. H. C. Wright, Mrs. R. W. Angus, Mrs. H. E. T. Haultain, Mrs. G. A. Guess, Mrs. J. W. Bain, Mrs. H. W. Price, Mrs. C. R. Young and Mrs. W. J. T. Wright to receive the guests.

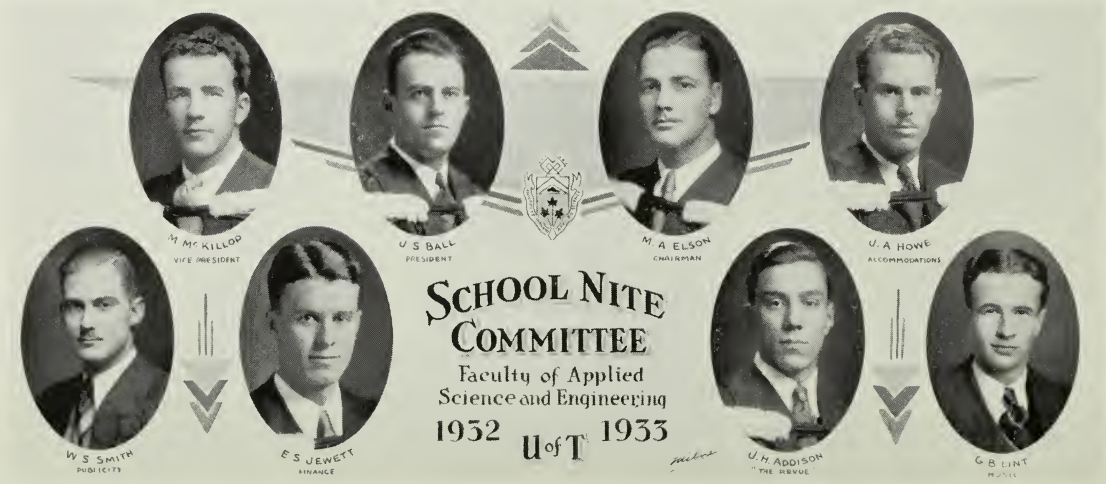
Although the attendance this year was quite small the quality of the dance was as enviable as ever. The music was all that could be desired and the midnight supper was very tasty.

Delightful favours and noisemakers were provided after supper and from the incessant din lasting 12.934 minutes, even the most casual observer would conclude that everybody was happy.

Contrasted to the warmth of the evening within was the chill of the winter air without. This meant many weary arms cranking many old cars and new. However, when one can tackle the problem of successfully putting over an At-Home, the problem of starting one's car is relatively negligible.

As the hundreds of cars streamed away from the hotel door bearing fashionably dressed ladies and meticulously groomed gentlemen, the gaiety subsided and the School At-Home was ended.

M. McKillop,
Chairman.


M. McKILLOP
VICE PRESIDENT
U. S. BALL
PRESIDENT
M. A. ELSON
CHAIRMAN
U. A. HOWE
ACCOMMODATIONS
W. S. SMITH
PUBLICITY
E. S. JEWETT
FINANCE
SCHOOL NITE
COMMITTEE
Faculty of Applied
Science and Engineering
1932 U of T 1933
U. H. ADDISON
G. B. LINT

School Nite

The night of Friday, January the thirteenth was the date set for our annual informal fling this year, and may I bring back fond memories by briefly reviewing this "nite" of nights.

By four o'clock Friday afternoon there was a complete sell-out of tickets with many late comers clamouring for the right to exchange $1.10 for the necessary piece of pasteboard; so that we may record this as a capacity crowd.

Differing from previous years, and combining all the skits into one "Stupendous Revue", the "Skit Men" left nothing undone to make this the best show that I have had the opportunity of seeing while at School. Bill Armstrong as the Russian dancer is voted as having stolen the show, while Ken Morris and his German band ran him a close second. George Lint and his court room scene were highlights of the show. Everything was run off smoothly by the master of ceremonies, Bob Anderson, although he was seen to have difficulty in squelching his wise-cracking accomplice Shepp, the voice from the past.

During the first performance of the Revue there was a water polo game and fancy diving in the tank, and all those who could squeeze their way into the gallery were well repaid for their efforts.

Cliff Young and his musicians supplied some of the best music heard at the University this year for all to dance to in the big gym, the east common room and the reading room; the popularity of this feature was evidenced by the difficulty that we all had in finding a few square feet to dance on.

As the clock struck ten-thirty, the doors of the great hall were thrown open and a ravishing throng quickly did away with all that Hart House could supply in the way of light refreshments. This assault continued until twelve o'clock.

This year we were honoured by having as patronesses: Mrs. C. H. Mitchell, Mrs. C. R. Young, Mrs. J. W. Bain and Mrs. E. A. Allcut.

The Warden of Hart House, Mr. Bickersteth, and his staff greatly aided us in arranging many details for our party, and to them may I extend our thanks.

May I take this opportunity to thank my fellow committee men and to tell you that each one carried out his numerous duties speedily and efficiently to give you fellows this night, and to them must go your thanks.

In conclusion may I suggest that next year you make this a bigger and better party so that all may say that at School we don't rest on our oars but ever drive ahead. Thanks, you fellows, for your whole-hearted support, for without that a committee is useless.

M. A. Elson,
Chairman.

J. J. DUTTON
SPORTS EDITOR
D. F. FRASER
EDITOR
J. A. MCMILLAN
3RD YEAR EDITOR
F. R. GORRIE
2ND YEAR EDITOR
W. S. SMITH
DIRECTOR OF PUBLICATIONS
W. R. MOGGRIDGE
ASST. EDITOR
M. P. JOHNSON
1ST YEAR EDITOR
TOIKE OIKE STAFF
Faculty of Applied Science & Engineering
1932 U of T 1933

The Toike Oike

Even Technocracy did not prevent the "Toike Oike" from completing another successful year. Indeed the principles of Technocracy were applied to most issues of the paper. Instead of putting the erg to work, the engineer was put to work. Result—numerous articles written by Schoolmen who had previously maintained that they "didn't think they had the ability to write."

The "Toike Oike" followed its usual policy of announcing the various scheduled activities of the Schoolman's life. Indeed the mere appearance of the paper was an indication that some important event was about to occur. This line of action was pursued so closely that no space was left for scandal or humour. But then this reduced the overhead costs by dispensing with the censors—"every engineer is by nature an economist."

A special department for sport news and announcements was established this year. It was in charge of a sports editor whose articles appeared under the heading "Sportoike".

The editorial staff functioned harmoniously at all times, and takes this occasion to thank all those contributors who helped to make this a record year.

DONALD F. FRASER,
Editor.

Gull Lake

Well, believe it or not, Gull Lake Survey Camp had the biggest year yet. We know that all the other years have said the same thing but we are going to prove that 3T4 camp was the best ever. To begin with it was the thirteenth camp and that sure had us scared at first but we changed that thirteen into a lucky seven.

From the first the weather was great and it did not take very long for the shirts and collars to come off. When the pains of the newly acquired burns wore off many big bronzed he-men wandered through the virgin forests.

The days were spent in hard work. Everyone shouted and sang, the woods resounding with the noise of brushhooks and hatchets cutting through the underbrush. The miners had a great time picking over cliffs and tapping rocks looking for the elusive pegmatites or what have you.

In the evenings the boys had a fine time dashing off the letter to the important one and keeping enough buttons on the pants for comfort. Stubbs supplied the music and he sure had everybody singing—whether they wanted to or not. Lyons, the first crooner on the lake went over big at camp even if they did give him the "bird" at Carnarvon. Speaking of Carnarvon, they sure threw some dances every Friday night. Boy! was that some blonde at the piano. There is one lad that hasn't forgotten her yet. Then there were the dances at Hall's Lake every Saturday night. Some

"TO THE LEFT — A PINK ONE."

ON THE LEVEL.

SONGBIRDS.

REGATTA DAY.

"A BUNCH OF THE BOYS WERE WHOOPING IT UP."

HOLD IT /

LAZY DAZE.

HOMEWARD BOUND.

GULL LAKE MINERS CIVILS. 1932.

of these will not be forgotten in a hurry either. The mailman is still busy. Within the first two weeks of camp a dance was held in the bunkhouse. That night the community certainly woke up to the fact that there were forty-odd engineers in its midst.

Then came the corn roasts, and what corn roasts! Never the like was seen on the old lake. The first one held on the lake shore was a grand success. The revellers returned to the bunkhouse to wake up the sleepy ones who resented it in no uncertain terms. However, everyone was ready for work the next morning—Oh yeah? The second roast held in the bunkhouse and led by "Worky" was a perfect evening.

Then came the Labour Day Regatta. There never was a bigger Labour Day than this one. Everyone entered without a single exception. The only drawback was that there were only ten Miners at camp and so the Civil-Miner feud was sadly lacking. However, this fact did not worry the Miners for their man won the highest honours with a Civil a close second. The only way they could put Sebolt out of the tilting was to knock his glasses off. Part of the afternoon was spent in diving for them. That night the bunkhouse was all dolled up and a dance was held. Music supplied by Stubbs stirred the boys up to a fever heat. Ner Tyson showed us how a square dance should be called off. The evening concluded with a swell feed—one of Mrs. Minto's best. Thus the day ended with a bang even though three fellows did spend most of the night standing in a marsh.

Some matters that still worry 3T4 are: Why was Stubbs seen running from Minden late one night with a dog on his heels? Who was the prominent young man that was always waiting so eagerly for the Lindsay bus? Why was Anderson always out on the lake paddling the funny little boat of his? How is it that Party 7 got further than anyone else on the Highway Improvement? How did precision Party 1 get along when engineer Wilson was away? Why did Jeffreys create such a liking for a certain schoolroom in Minden? Why was Johnson sitting on that pipe near the ceiling of the bunkhouse? Why is it Donnelly could never find the door at night?

Why did five fellows play poker all night and then wonder why they couldn't see the rod in the morning? How is it Rule was always looking for an anvil every time he went out? Why were Macdonald and McBride so anxious to go camping that night in the pouring rain?

On the last night the camp ended with a bang. There was a wedding dance in Minden. You haven't seen life if you haven't been to a wedding dance in Minden. For a while the action was fast and furious but the boys did get back to camp in time to get out by 5 a.m. for home. Thus ended a perfect six weeks.

3T4 now feels sure that they have convinced the other years that no other time can equal this, and that 3T5 will have to go some to make the fourteenth camp bigger and better in all ways.

Our Column.

E. H. SINCLAIR
VICE PRESIDENT
J. R. FITZPATRICK
PRESIDENT
Prof. J. W. BAIN
HON. PRESIDENT
K. C. H. McNICHOL
SECY TREAS.
L. V. LICHTY
4TH YEAR REP.
E. O. HALLETT
3RD YEAR REP.
ATHLETIC ASSOCIATION EXECUTIVE
Faculty of Applied Science & Engineering
1932 U of T 1933
G. H. SCOTT
2ND YEAR REP.
J. A. UPPER
1ST YEAR REP.

The School Athletic Association

School, while not having an exceptionally successful year as far as championships go, still held its prominent place in Interfaculty Athletics.

The Gym team and the Swimming team were both victorious, both bringing their championship cups down to School.

Just to show how strong Athletics have been, we have had runners-up in the Sr. Waterpolo, B.W. & F., Soccer, Track, Sr. Basketball, Sr. Baseball, Jr. Baseball and Sr. Hockey.

As for Interfaculty Semi-Finalist teams, which have put up real battles in their respective sports but have just been unable to snatch victory from the lap of Lady Luck, we have these; the Jr. Waterpolo, the Sr. Rugby, the Jr. Rugby, Sr. Basketball, Sr. Baseball, Jr. Baseball and Senior Hockey.

Besides, Interfaculty Athletics, School provides a large representation on the Intercollegiate teams. Our wish is, that they continue to hold their high place.

J. R. FITZPATRICK,
President.

School in Intercollegiate Sport

Men from the "Little Red School House" have been quite prominent in intercollegiate sport during the past year, and in many cases they have played a prominent part in bringing the highest honours to School.

First of all let me mention the chaps who helped the rugby team in its sweep to the Intercollegiate and almost to the Dominion Rugby Championship. Peacock at middle wing turned in a sterling game whenever he was called on to "go places" which was just about 95 per cent. of the time. Elson at outside brought them down often and hard. Miller at quarterback although new to the squad turned in some very good games. Fitzpatrick helped Elson.

On the Rugby Second team Burgoyne, Smith and Webber held down half-back positions while Bell was the mainstay at the centre of the line. All these men showed beyond a doubt that they could hold a place on any man's team. Smith's fort was hitting them low, and when I say hit, I mean h-i-t. Burgoyne and Webber showed all the lads how to crack a line.

On the Rugby Third team Scott at middle and Upper on the half line, helped the Juniors to a Canadian Championship. Big things are looked for when these lads step up into senior company.

The Senior Hockey squad claimed Don Smillie, without doubt the outstanding player of the team during every game.

The Senior B Hockey squad had Williamson, McNichol and Murray on the ice. These lads helped materially in getting the Sr. B's as far as they went.

S.P.S. "T" HOLDERS

Back Row: G. A. Dowling, C. L. Annis, D. W. W. Smillie, S. C. Swallow, R. Westheuser, B. S. Crocker, K. A. Peacock.
Front Row: J. B. Gray, W. D. Smith, C. E. Bannister, J. R. Fitzpatrick, M. A. Elson, R. H. Miller.
Absent: H. R. Collins, C. B. Britnell, F. N. E. Murray, F. A. Fell.

On the Juniors Upper played forward. Rather a versatile chap.

The Intercollegiate Rowing Title was won by Varsity at McGill. Annis and Dowling both swung a wicked oar to help annex the title.

On the Varsity Gym team Beard and Sherwood did their part to help in winning the Intercollegiate Championship.

On the 140 pound crew that rowed at Henley Baird, Fry, MacDonald and Rule each took a prominent place.

The lads in the "Biff Bang and Soccem" league had quite a time this winter ending up by taking the intercollegiate title at McGill. F. Smith won his weight in boxing. Sinclair lost to Peever after a most spectacular bout. Elson had the narrowest of narrow decisions against him, and Big George Fairlie handed them out left and right only to be outpointed. In the wrestling Dimitrieff and Gray both won their weights. Unfortunately Dick had to give way to another lad, but we can't win them all.

The Senior Basketball team had quite a successful season. They won the city championship and then withdrew from competition. None other than "Hal" Collins showed the boys how to "drop them through."

The Water Polo and Swimming squads claimed Swallow, Bell, Hooper and Weir. Swallow (a good name for a swimmer) helped the senior Water Poloists to the championship. Bell, Hooper and Weir all took prominent parts in the swimming meet, Hooper winning the 440. On the Water Polo Juniors, both Wood and Towers showed to advantage.

Carruth was our only entry in the Intercollegiate Tennis. I would that we had more like him.

The track team had a real tough "row to hoe" this fall. Through no fault of the lads, McGill swept on to Victory. However, one of the highlights of the meet was provided by Westheuser, when he heaved the old discus for a new mark. Hickey, N. Smith, Byrne and Westheuser played prominent parts.

So School still supplies mighty men for intercollegiate meets, as of old.

SCHOOL "S" HOLDERS

Back Row A. W. Moffat, W. J. Beynon, E. S. Jewett, E. A Mabee, R. G. Westheuser H. G. Waring, S. Tenenbaum, B. L. Bryant, F. R. West, F. V. C. Hewett.

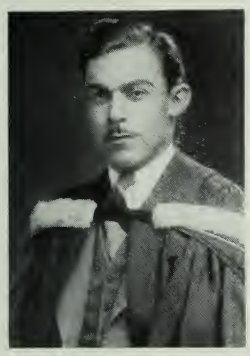
Fourth Row: G. Dimitrieff, H. F. Bengry, A. W. M. Carmichael, W. R. Coulter, G. A. Dowling, C. L. Annis, J. B. Gray, W. A. Wood, R. E. Carruth, G. F. Fry.

Third Row: A. Monsaroff, K. G. Mitchell, H. F. Wheaton, H. M. Jones, F. J. Billett, G. H. Scott, R. H. Miller, B. S. Crocker, F. R. Adams, H. K. C. McNichol.

Second Row: W. D. Smith, C. E. Bannister, W. R. Sirman, L. B. Jones, J. H. Byrne, E. R. Eaton, C. W. Tyson, Y. L. Wong, S. E. Swallow, D. W. W. Smillie, K. W. Peacock.

Front Row: F. N. Smith, E. H. Sinclair, F. J. Hickey, A. J. Leary, J. R. Fitzpatrick, J. P. Hooper, W. W. Freeland, M. A. Elson.

The Bronze "S"



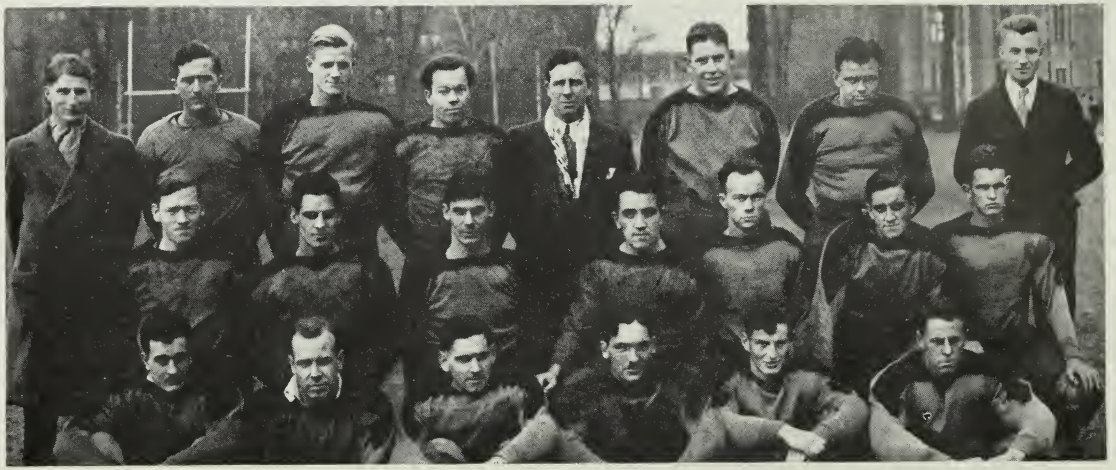
The holder of this year's Bronze "S" has perhaps the most glamorous reputation of all the recipients of this distinction for many years. "Johnny" Fitzpatrick is well known to us at School. He is liked wherever he has been and is welcomed wherever he goes.

Johnny was born on the twenty-first of March, 1907, in a parsonage in Toronto. At that time we can safely bet the first thing he did was to make friends and take for himself a place in the hearts of all present.

At the age of fifteen Johnny met Cap. Cornelius of Hamilton Central Collegiate and the outcome of that friendship, as we all know, has been both pleasant and fruitful. The story is that John started with the mile run at which he was of course good, but he proved progressively better as he tried the half mile, the quarter, and finally, the sprints, the reason being given that the less effort required the better John performed. Thus by 1928 John had improved so well as a sprinter that he was chosen to represent Canada in that capacity at the Olympics, where he was a point winner in the 220 yard event.

However, during the period of glamour that always follows such successes, of trips to exhibition meets all over the country, from Halifax to Vancouver, and the many newspaper gossips of romantic engagements, John still had his heart set on an education, and like all wise men chose School. While here he has been very active in bringing honours to our faculty. In '29 he broke four records during the interfaculty track meet at Hart House. He equalled the intercollegiate time for the hundred yards and has placed for the Varsity Senior Rugby team every fall. This last year he has demonstrated once again his worthiness in his capacity as president of the Athletic Association of our faculty.

Nevertheless, in spite of his many successes, his fame and popularity, the thing for which alone he might well have been awarded the Bronze "S" is the fact that through it all he has never ceased to be other than his own likeable self—Johnny Fitzpatrick.



SCHOOL SENIOR RUGBY

Back Row: West, Hayhurst, Beynon, Mitchell (Manager), MacMillan (Coach), Moffatt, Symons, Hewett.
Centre Row: Farquhar, Boyd, Glover, Monsaroff, Wheaton, Mabee, Finch.
Front Row: Coulter, Brandt, Freeland, Hallett (Captain), Waring, McNichol.
Absent: Hill, Bridgland, Gurney.

Senior Rugby

The Senior School Rugby team was again jinxed in its efforts to bring the Mulock Cup back to its rightful home. When I say jinxed I mean that we were unfortunate in several ways.

First we did not have enough opposition in our group games. This left us unprepared and inexperienced for a tough game, but a few practices with the Varsity Juniors helped a little.

Then the casualties weakened us considerably. The first practice saw two good men, in Jim Eaton and "Pete" West, laid up for the rest of the season. Then just when "Harp" McNichol, our stellar half-back, was showing the opposition how rugby should be played, he had his shoulder dislocated.

Even the Weather Man "played us dirt", that is he gave us a field that was frozen as hard as a rock and partly covered with ice for our game with Vic. To play on a field like this took plenty of courage but School was not lacking in this department. Every member of the team fought all the way but Lady Luck would not smile.

To mention any individual as star is perhaps unfair because every one gave their best. But I think that "Harp" McNichol was outstanding and "Ned" Hallett, the captain, and "Chuck" Bridgland deserve honourable mention. The line play of George Brandt against Vic. was outstanding. Also the two quarter-backs, Waring and Wheaton, deserve mention. Both of these men never missed a practice and were always the first on the field and the last to leave.

I would like to take this opportunity of thanking "Scotty" MacMillan, for his untiring efforts to mould us into a championship team.

In conclusion I wish next year's team the best of luck and hope they win the Mulock Cup.

F. G. Mitchell,
Manager.

School in Interfaculty Sport

School did not have an exceptionally successful year as far as championships go. But true to tradition, it still holds a prominent place in Interfaculty Athletics.

The Gym team and Swimming team were both victorious. These two teams defeated everything in sight and brought championship cups to School.

The B.W. & F. Club won the Junior Assault and were runners-up in the Senior Assault. Besides this, its members won many points for Varsity on the Intercollegiate teams as well as championships for themselves.

The Junior Water Polo walked through their group with little trouble but were defeated by Victoria in the semi-finals. A similar

S.P.S. B. W. & F. TEAM

Back Row: J. F. Fairlie, R. H. McKillop, G. H. Fetterley, S. G. Fearman, J. M. Troseir, P. M. Hedley.
Middle Row: G. Dimitrieff, E. R. Eaton, W. D. Smith, F. N. Smith, H. J. Ostrowski, E. H. Sinclair.
Front Row: C. W. Tyson, J. J. A. Howe, M. A. Elson, C. E. Bannister, O. F. Bush, J. H. Gray.
Absent: H. Hoseason, A. E. Rule.

fate met the Senior Water Polo team. They also won their group and drew a bye for the finals but were beaten by Victoria.

The Track Outdoor was defeated by U.C. but they put up a great showing. If the same men are out next year, the cup should be back with School.

The Track Indoor were defeated but they won the relay which is an important event of the meet.

The Senior Rugby had little trouble winning the group and were picked to win the Mulock Cup. They lost, however, in the semi-finals.

The Junior Rugby had a real team but did not win the group. They showed up well, however, and should have been in the play-offs.

The Soccer team won their group and nearly upset all the dope by giving the strong Knox outfit a real battle in the semi-finals.

Junior Basketball had a strong team but were unlucky enough to lose to O.C.E. by one point in a battle for group honours.

Senior Basketball beat Senior Meds in the semi-finals only to lose out on the title to Junior Meds.

Junior and Senior Hockey both fell by the wayside. The Seniors made a strong showing but they lost to Dents which put them out.

Junior Baseball won their group with ease, only to be defeated by Senior Victoria in the finals.

Senior Baseball had a strong team but were defeated by Senior Victoria in the semi-finals.

The above brief resume of our achievements shows that School is still keeping her high standard in interfaculty sports, and our wish is that she continue to hold her high place.

School B. W. & F. Club

When the football season was over, School's boxers, wrestlers and fencers thronged to Hart House to start getting into shape for what turned out to be a long and strenuous period of training.

The first opportunity our men had for competition was the School Assault, held Wednesday, November 30th with bouts being put on in the afternoon and evening. The School Assault is thrown open to men who have not had extensive experience, its main purpose being to uncover new material. If a man had won his weight the previous year, he was permitted to step up a weight the next year, so that the beginners would be encouraged and not have to knock a champion over. There were numerous entrants this year, many showing themseves to be far from the novice class, and thus the spectators were shown plenty of action, for all entering the ring seemed eager to call curtains for their opponents. The wrestling entries far outnumbered the boxing this year, so that the fans got many opportunities for a comparison between amateur and professional wrestling. When the preliminaries and finals had been run off the following men found themselves eligible for the gold medals given to class winners.

Boxing—Fairlie, Smith and Sinclair.

Wrestling—Mason, Fearman, Dimitrieff, Eaton, Agnew, Howe, Cowie and Barber.

Fencing—Thompson.

The runners-up and winners of these bouts then entered the Junior Interfaculty Assault and put up a very creditable showing. The following are the winners:

Boxing—Fairlie, Eaton, Gauvreau, Hedley and Bush.

Wrestling—Tyson, Dimitrieff and Howe.

After Christmas holidays all those men willing to spend precious time continued turning out every night at Hart House. May I say that much credit is due these fellows, for anyone that has worked out at Hart House knows that to have to sit up afterwards and do a lab, or study, is tough going.

When a month of strenuous training had been put away everyone on the team felt confident of bringing honour to School in the close approaching Senior Interfaculty Assault, if not with a win, then with at least a good effort.

When the first day of the assault arrived Schools' representatives appeared in trunks second to none and the fact that they were from S.P.S. was clearly shown by these three letters in white and gold sewn on the left leg.

After many tough bouts and a few close decisions the score showed that O.A.C. led with 70 points and School followed in second place with 45. Last year we only scored three points, so that if this year's result is any criterion to go by, O.A.C. will soon be minus a cup which we held two years ago. The winners for School were:

Boxing—Fairlie and Sinclair.

Wrestling—Gray.

There were four Schoolmen on the University Boxing Team that fought at Syracuse University in January, namely—Fairlie, Elson, Bush and Smith. Hedley turned in a win for School in the Intermediate Interfaculty Assault held in February.

The last assault of the year, and one which seems to be too close to exams for most of us, was the Senior Intercollegiate at McGill. School supplied seven out of nineteen of Varsity's representatives, a record to be justly proud of. The men were:

Boxing—Fairlie, Elson, Sinclair and Smith.

Wrestling—Gray, Dimitrieff and Dick.

Smith, Gray and Dimitrieff won their weights, thus bringing three more first "T" 's to School.

To even the most severe critics this has been a very successful year at School for the B.W. & F. Club, and may I take this opportunity to thank all of you for the conscientious effort you made this year. Your showing does us credit and School is proud of you. Next year get the cup back from O.A.C., and once back, hold it here for good. The best of luck in the future and, always remember—keep fighting.

M. A. Elson,
Manager.

Junior School Rugby

The season of 1932 opened with the appointment of "Chuck" Austin as coach. We feel that Chuck is to be highly congratulated for the results he obtained with the team in the short time at his disposal. The first game took place hardly a week after organization. The task of selecting a team from the large turnout, and of training it, was a difficult one but no time was lost.

Five days after getting together, the Juniors defeated our impressive Senior School team by 7 to 5. Then Junior Meds fell 7 to 2. The next week with the team working smoothly they ran up the nice score of 16 to 1 against Forestry. Trinity came next, and it was a tough battle on a muddy field in a drizzling rain. George Peacock intercepted a forward pass to run 75 yards for a touchdown to win the game with a score of 6 to 5 over last year's Mulock Cup winners.

Leading the group by a wide margin the team next met Trinity in the return game only to lose by 18 to 1. Then, still in the running, the team settled down again but took a heart-breaking defeat from Forestry to the tune of 2 to 0. Trinity finished the season a single point ahead.

The team was made up of Thomas, Brunette and Sharpe, middles; Baker and Boyle, insides; Gilpin, snap; Edgar, Peikes, McArthur and Dawson, ends; Hall, captain, quarter; Boomer and Walden, outsides; Ballantyne, flying wing; Peacock, Hamilton and Jeffrey, halves; Wood, Barrett, Powlesland and Hawker, subs.

A. C. KING,
Manager.

Outdoor Track Team

Unfortunately, it can not be said that School's track team won the interfaculty track championship for the fifth consecutive year. Due to the loss of such stalwarts as Ralph Adams, Johnny Fitzpatrick, and Eddie Peaker, the team was not expected to make such a remarkable showing. However, the boys did nobly and U.C. was only successful by a four point margin.

Outstanding among the performances was that of Westheuser who shattered both the intercollegiate and interfaculty records in the discus throw by making a mighty heave of 120 ft., 2¼ in. Much is expected of him in the future years. John Hickey displayed great form in the hurdles to gain ten points for the team. This enabled him to tie Maundrell and Engel of U.C. for individual honours. Smith, a freshman, ran cleverly in the sprints.

The lack of middle distance runners was again evident. Nevertheless, with the new material in sight it is to be hoped that School will regain her former proud position.

J. J. A. HOWE,
Manager.

SCHOOL SWIMMING

Back Row: Ridley, Swallow, Webber, Nasmith, W. Wood (Manager), B. Wood, Vessie, Crawford.
Front Row: Conron, Hawke, Bruce, Fitzgerald (Coach), Fraser, Keith, Holland, Dance.

S.P.S. Swimming Team

INTERFACULTY CHAMPIONS, 1933

School again annexed the Fitzgerald Trophy, emblematic of the interfaculty championship, but only after a strong finish in the relay, nosing out U.C., the runners-up by 2 points.

Practices did not start until late in the season, and for a time things looked dull. However, the acquisition of Mr. Fitzgerald as coach, a good turnout, and the showing of some first year men worked wonders.

In the 200-yard free style, Swallow annexed the first point with a third place. Due to sickness, School was not represented in the diving, but Nasmith swam a beautiful race in the 100-yard backstroke to gain a first place. Hawke and Conron boosted the total to 12 points with a first and third respectively in the 100 yards free style. Wood finished strong in the 200-yard breast stroke to gain a second place. In the 440-yard free style, a win for U.C. and Sid Swallow's third place tied up the meet at 16 points each, thus making the relay the deciding event of the meet.

Webber, Vessie, Keith and Conron all swam a great race to win the relay and with it the meet. The second relay team of Bruce, Dance, Hollands and McCatty made a great try for third place, but were nosed out. Crawford made a good showing in the breast stroke as did Ridley in the backstroke.

To Mr. Fitzgerald, the coach, the team owe not a little of their success, and with the formation of the School Swimming and Waterpolo Club this year to foster these sports, practices will be started earlier next year in defense of the trophy.

W. A. Wood,
Manager.

Senior Lacrosse

Forestry and Sr. S.P.S. started the ball rolling but alas! they forgot about the ball and a survival of the fittest ensued. The locals finally out-chopped the "Woodsies" 7-5.

Sr. School next met Vic. and were in the lead when the game was called off at half-time.

In the replay, the Seniors led 8-6 at full time but Messrs. Ken, Parkinson and McCutcheon prolonged the game until Vic. finally won 8-10 at about 5.25 p.m.

Forestry and S.P.S. locked horns again and a swell game resulted. At 4.15 p.m. we trailed by one goal, but by 5.01 p.m. the score stood 10-7 in our favour.

Vic. met Sr. School next with eleven men, 10 in uniform and one referee but we managed to beat the "Combines" 9-7.

SENIOR SCHOOL WATER POLO TEAM

Back Row: W. A. Wood, J. C. Towers, T. Bell, R. A. Webber, F. H. Adamson.

Front Row: L. D. Dougan, H. M. Jones, D. F. Fraser, S. E. Swallow (Coach), C. E. Hawke, F. R. Adams, L. R. Brown.

This necessitated a play-off. The winner was to meet O.C.E. in the finals for the Dafoe Cup. In this game, two loyal Artsmen gave Vic. the call over S.P.S. 7-8 yet School scored 9 legitimate goals and Vic. only found the net 7 times. A protest on five counts was submitted but it must have met a fiery grave.

The team:

Kennedy—Keith was a swell man between the posts.

Webber—Bob was great and gave Keith lots of protection.

Knapp—Clayton was our smoothest stick handler and was always a threat.

Caldwell—Ed and Bell proved a wonderful combination.

Bell—Tom was our star and his play was a revelation.

Muir—Crawf was a pip of a Home and he hit the net plenty.

Dolbear—Ace fitted in nicely with our attack.

Strachan—Dave was one of our bone crushers.

Burgoyne—Bill could knock them kicking with a vengeance.

Walters—Paul came on and they dragged the bodies off.

Senior School Water Polo

With practically the whole Junior team of last year moving up to Senior company, prospects were bright for a good season. Regardless of the dopesters, the Senior team beat Senior U.C. in both games, although some of the forwards seemed to think that the goal was 6 ft. high. The usual "friendly" game with Sr. Meds resulted in a tie and then in the second game, some good goalkeeping and the old School spirit resulted in a 3-1 win for School and the group championship.

Sr. School, having drawn a bye into the finals, prayed and cheered for the Jr. team to beat Victoria, the defending champions, and thus cause an all-School final. However, Victoria had other ideas, and in the first game, an off night and a Victoria team playing championship polo, gave Victoria an almost unbeatable lead of 8 goals. The second game was much closer, with the team playing their usual steady game, and only losing by the odd goal in five, after holding a 2 goal lead until near the end of the last period.

Next year, with almost the whole Junior team moving up, and almost all the Senior team remaining, prospects are bright for the championship.

"Tubby" Bell again swam centre and played a star game, as did "Basher" Hawke and "Jimmy" Towers, his wingmen. "Don" Fraser, the spark plug at rover, covered more water than any six other men. "Mase" Jones and "Cap" Wood on the defense gave opposing forwards a tough ride and "Pinky" Brown backed them up ably in goal. "Bob" Webber, "Franky" Adams, "Lee" Dougan and Frank Adamson rounded out a well balanced team. And last, but certainly not least, Sid Swallow, our coach, the man behind the scenes, did his job well and deserves his share of credit. However, next year may tell a different story.

W. A. Wood,
Manager.

SCHOOL TRACK

Back Row: G. R. Bruce, C. W. Dolbear, J. A. McArthur, R. D. Walden, F. N. Smith, J. J. Hickey, M. Saunders.

Front Row: J. S. Ferguson, F. Krailo, J. H. Byrne, Prof. Allcut, T. Bickford, J. A. Howe (Manager); R. Westheuser.

Indoor Track Team

Due to lack of enthusiasm on the part of the men, the Indoor title this year went to U.C. by a wide margin. It seemed evident from the start that School would make a poor showing as most of the boys forsook the glories derived from track in favour of those obtained from studies. After all most of us are here for the purpose of studying and too much interest can not be taken in any sport after Christmas. It was also difficult for the boys to miss labs in order to compete. There you have the reasons for the team's downfall.

However, in view of such circumstances, a few noteworthy performances were turned in. The sprint relay composed of G. A. Stammer, R. C. Mitchell, J. H. Byrne, F. Krailo, C. W. Dolbear and E. R. Eaton ran a sensational race to win the event. The team of R. Robinson, J. H. Byrne, R. C. Mitchell and F. Krailo also did well in placing third to such strong contenders as Trinity and U.C. in the mile medley. Only one second separated the first and third teams, thus proving that the race was not a walk-over.

There were few sterling individual efforts except those of Ferguson in the pole vault, Robinson in the broad jump and Byrne in the sprints which are worthy of mention.

It is to be hoped with the fine material in first year and prospects of newcomers entering next year that School will once again regain the top rung in Interfaculty competition.

J. J. A. Howe,
Manager.

The Rifle Assocation

This year the membership of the University Rifle Association reached 90, the highest since the war.

Slightly over 50 per cent. of this membership is made up of Schoolmen, which is as it should be for the good of all concerned.

The year was begun by taking off labs and lectures (unfortunately) to go out to the Long Branch Ranges two or three times a week, use a lot of ammunition and have a good time generally.

The Intercollegiate and Interfaculty Service Rifle Matches were held concurrently at the end of October. This Match is fired at 200, 500 and 600 yards. Everybody shoots. The 8 highest men make up the Intercollegiate Team, and the 5 highest in each faculty constitute the Interfaculty Teams.

The Intercollegiate Team placed third to New Brunswick and Queen's, and this brings us to the sad part of this story. In spite of the 50 per cent. membership, not a single Schoolman made the Intercollegiate Team, and not only that but they allowed Arts to take the DeLury Shield in the Interfaculty Match. The only success for School during the day was the O.R.A. Silver Medal, which was won by the writer in the Extra Series Match. Now you must

SENIOR SCHOOL HOCKEY TEAM

Back Row: Finch, Ellsworth, Moffatt, Mitchell (Manager), Bell, Kennedy, Werry.
Front Row: Caldwell, MacLachlan, Bridgland (Captain), Hickey, Wheaton.

realize that this sort of thing cannot go on, so come out next fall and give your support.

In the Indoor Spoon Shoots in Hart House, School was again evidently shooting in the air. Of the 12 spoons competed for, only five have come to School.

In the Interfaculty Match, however, School rallied, and won the Mitchell Cup for the second year in succession. This match consists of three targets fired in three different months. The School team finished with an average of 92, the members being, Broad, Jordan, Howard, Clark and Thompson.

The scoring for the eight Henderson Pins is not yet complete, but an unofficial advance report has it, that at least three Schoolmen will be in there this year.

Meanwhile, we are looking forward to the Annual Banquet, and those of us who will soon be leaving School for the "breadlines" will do so with the sincere hope that at Long Branch next fall, School will give a better account of themselves.

To those of the incoming first year, and any others who may be interested, we may say that you will find a warm welcome and a good time awaiting you in the Rifle Association.

J. M. Jordan,
School Representative.

Senior School Hockey

Senior School again failed to win the Jennings Cup, not due to the lack of spirit or fight, but because we lost one of those games that was anybody's until the final bell had rung. Our group was very evenly matched and close hard-fought games were the result.

The first game resulted in a 5 to 4 victory over Sr. U.C. The next game was against the fast and smooth-working Dents team, and we were defeated in a close and keenly fought game. The score was 2 to 1 for Dents. Sr. Meds gave us a great old battle before they went down by the score of 2 to 1.

Every member of the team did his best at all times. "Chuck" Bridgland, the captain, played a "bang-up" game at right wing and was the team's high scorer. He was given many assists by the great play-making of MacLachlan and Ellsworth. Finch, Hickey, Caldwell and Wheaton were trying at all times and made things interesting for the opposition. Kennedy stepped into all comers with very effective body checks and was capably assisted by Moffat and Wilson. Werry certainly knows how to keep the puck out of the goal, and every goal that was scored was of the kind that nobody stops.

I would like to thank the players for the wonderful spirit and co-operation shown both at the practices and games, and also to thank the Athletic Association for their co-operation and support. May Senior School win the cup next year.

K. G. Mitchell,
Manager.

SCHOOL SENIOR BASKETBALL

Back Row: A. Hagerman, R. Cahoon, L. Lichty, B. Cooperman, K. Black, H. Wilkinson.
Front Row: J. Hall, L. Wong, S. Tenenbaum, C. Britnell, T. Douglas (Captain).

Senior School Basketball

This year's edition of the Sr. S.P.S. Basketball team gave a very creditable performance in the interfaculty series, having fought their way up to the finals, only to succumb to the champion Jr. Meds, after a hard struggle.

Starting the season inauspiciously, School went down to defeat in their first game to Sr. Vic, last year's champions. Then followed a string of victories which was unbroken until the finals. Two defeats were inflicted on Sr. Dents and one on Sr. Vic to tie the group. In the playoff, Sr. S.P.S. outpointed Sr. Vic 24-19 to capture the group and the right to enter the playoff.

The first round was won against Sr. Meds, the Schoolmen taking two straight games from the Medicos by a good margin.

A sudden death game with O.A.C., resulted in another victory for School, and the right to enter the finals against Jr. Meds.

In the first game, Sr. School were below form and took a 36-17 defeat. However, they came back strong in the second game, and only went down to a 28-24 defeat after a hard struggle; the game being in doubt until the last minute. School were weakened by the absence of one of their best players, Douglas, who was out of the game due to an injury.

During the season a trip was taken to Hamilton and the Schoolmen registered a victory against the combined Junior and Intermediate teams of McMaster University.

With only five of this year's team graduating, School have a a strong nucleus to build around next year, and it is hoped that School may once again regain the Sifton Cup, emblematic of the Interfaculty Championship.

All players gave of their best when called upon. Douglas, Black, Wilkinson and Wong played strong offensive games and were backed up by Cahoon and Lichty on the defense.

The teams:—

Centres—K. Black; H. Wilkinson.

Forwards—C. Britnell; E. Douglas; J. Hall; M. McKillop; L. Wong.

Defence—R. Cahoon; B. Cooperman; A. Hagerman; L. Lichty; S. Tenenbaum.

S. Tenenbaum,
Manager.

SENIOR SCHOOL BASEBALL TEAM

GROUP CHAMPIONS 1933

Back Row: K. B. KENNEDY, C. B. BRITNELL, W. O. McBRIDE, A. W. M. CARMICHAEL, T. C. MUIR, F. V. C. HEWETT.

Front Row: J. P. BORBEY, W. S. SMITH (Manager), J. J. A. HOWE (Captain), T. J. CARBONE (Coach), T. J. WELLS, H. H. JOHNSTON.

Absent: P. J. HOWE, G. W. WILSON.

Senior School Baseball Team

Living up to tradition the Senior School Team again became the champions of their group in the Interfaculty Baseball Series and managed to reach the semi-finals. Senior School was grouped with the "pill rollers" from Pharmacy and the "tooth-pulling" aggregation known as Dents. However School emerged from this spirited four game series without a loss.

Then Senior School were drawn to eliminate that demon team from O.A.C. On Saturday March 4, still slightly groggy from the School elections, the team played real baseball and won the game 13 to 5 in spite of the small space, many arguments and loud jeers. A week later a bolstered O.A.C. team playing a better brand of baseball defeated School in Hart House Gym but failed to overcome the 8 run lead.

The Senior Victoria team now loomed on the horizon and spoiled our chance at the Spalding Cup. School won in the first encounter 8 to 3 and looked like the championship team. Victoria managed to eke out a victory in the second game due largely to the weakening of the infield when Joe Howe was disabled. Howe, our veteran third baseman, severely sprained an ankle when desperately attempting to make another run for School. The final game saw an anxious, rearranged School team facing a confident Victoria nine. The game was not decided until the last moment when the scarlet and gold again wrested laurels from the blue and gold.

This was the final year for five of our players—G. W. Wilson, the veteran pitcher who struck out his share, J. A. Howe and P. J. Howe who maintained the steadiness of the infield by their alertness at first and third bases, and A. W. M. Carmichael, and F. V. C. Hewett who rank first among the outfielders of the league.

The remaining players will be out battling for the cup next year—H. H. Johnston who as catcher took everything coming his way, T. J. Carbone and T. C. Muir,—shortstops who understood that no ball was to pass them, and T. J. Wells who was more than an ornament on second base.

Emergencies often occurred but with players like J. P. Borbey, W. T. McBride, K. Kennedy and C. B. Britnell, the gaps were always perfectly filled.

Although they were just unfortunate in missing the finals the team deserves the highest praise for their showing throughout the series. They played "heads-up" baseball at all times and were of real championship calibre.

W. Stanley Smith,
Manager.

Matt Hazy Mark Bill Bill Jack Ref Gus Harold Steve
Hard Little Bayley Fraser Crawley Paterson Harvey Bartlett Masson Reynard
Coach Centre Right Half Right Back Left Back Inside Right Goal Outside Right Centre Half
S. P. S. Soldiers Spacers Team
Group Champions 1932

SCHOOL SOCCER TEAM

Group Champions 1932

School Soccer

The team fielded for this year was largely composed of last year's players, and with this encouragement we aimed at the Interfaculty Championship.

The freshmen were slow in turning out, and gave us little opportunity to improve on the team before the games started. We were grouped with Meds and Wycliffe and our first game, after much practice, was a bad disappointment. Meds won 2-1 and we realized we needed to work harder still if we were to get anywhere. From then on School did not lose a game until they reached the semi-finals. It was necessary, however, to play off a tie with Wycliffe before we could get into the semi-finals.

For the semi-finals we had to play two games with Victoria, and goals were to count. Vic. won the first game 2-0 on an icy field at the stadium. The second game was on the front campus with a slight improvement on ground conditions, and ended in a 1-1 tie. This brought a finish to School Soccer for the year.

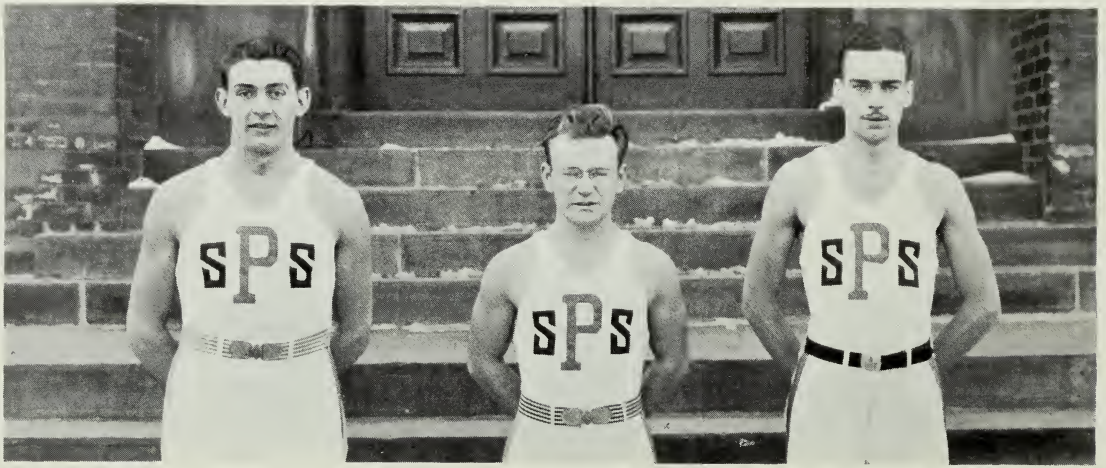
Professor Allcut and Matt Ward endeavoured to show us the way we should go but were not able to devote as much time to it as they would have liked.

J. A. C. Bowen,
Manager.

Junior Basketball

This year for the first time, Jr. School were grouped with Grad. Studies, O.C.E. and Wycliffe. And with the Grads captained by the perennial star, Hucheson, an old Schoolman, keen rivalry was in store for us. With two impressive victories over Wycliffe and Grads, group honours and even the cup seemed headed for the old "School house." But, School with a team of young, inexperienced players were unable to make much headway against the cagey teachers who were led by Young, the ex-Western University luminary. The next two games were taken quite handily, and with a victory meaning a group tie, faced O.C.E. in the return game with renewed strength and confidence. The final score was 17-16 in favour of O.C.E. and there lies the tale! And so the uniforms go back to the moth bags for another year.

The team was handled by Hugh Wilkinson and Lang Wong, who shared the training duties and they handled alternate games because of the heavy schedule.



SP.S. GYM TEAM

Winners of H. A. Wilson Trophy

M. L. Sherwood G. F. Beard W. R. Sirman

S.P.S Gym Team

School was again successful in capturing the Harold A. Wilson trophy for Gymnastics, the team being composed of G. F. Beard, M. L. Sherwood and W. R. Sirman. The first two were successful in winning a place on the victorious Varsity Intercollegiate Team.

School has been well represented at the regular workouts and provides, especially in the first year, an excellent choice of material that should stand a good chance of coming out on top again next year.

Junior School Hockey

As in former years, Jr. S.P.S. was represented by a well-balanced hockey team. From the first the turnouts were encouraging and the members of the team were very enthusiastic.

After a few practices, the team staged an exhibition match with Forestry and came out on top by two goals to one.

The first scheduled game was against Jr. Meds and the boys experienced little difficulty in trimming them three to one.

Junior University College were the next victims and they were taken into camp by the same score as the embryo doctors.

The low scoring of the opponents was, for the most part, due to the sterling efforts of Jack Biddle, School goal-keeper, who turned out at the last minute and saved a serious situation, that of having no net-minder. Indeed, it is doubtful whether we and Meds would have soiled the score sheet if Jack had not been engaged in conversation with "Stew" Hamilton, our faithful trainer, coach, and all round supporter who was goal judge behind Jack's net at the time.

Our conquerors, Victoria College, were the ultimate winners of the Jennings Cup and their gzme with Jr. S.P.S. almost proved a stumbling block. However, the better team won and the boys did not complain about the short end of a 3-1 score.

Many of the members of the squad were from first year and Jr. School can look forward to an even better team next winter.

The players: Biddle, Davidson, Press, Brunette, Fiebig, Kerr, Black, Hewitt, Terry and Patterson.

George T. Boomer,
Manager.

JUNIOR SCHOOL WATER POLO TEAM

Back Row: H. B. Charters, R. A. Boyle, J. P. Hooper, D. B. Bruce, E. D. Heller.

Front Row: V. Zachanko, J. N. Lilley, W. A. Wood (Manager), K. H. J. Clarke, D. F. Fraser (Coach), M. W. Hollands, E. R. Eaton.

Junior School Water Polo

With only one regular left from last year, Jr. School seemed due for a lean year, but the combination of Don. Fraser as coach and the co-operation of a willing if "green" squad soon welded a typical School team together.

The team rode roughshod over all opposition in their group games, trouncing Jr. Meds by 3 to 1 and 4 to 0, and Dents by 3 to 0 and 1 to 0, only one goal being scored on "Ron" Boyle, the goalie.

However, in the playoffs, lack of experience told the tale and although the championship Victoria team mopped up the pool with the School team 7-0 in the first game, a close checking, battling Jr. School team only went under by the only goal scored in the second game.

In goal "Ron" Boyle showed his real class and is a sure fire intercollegiate prospect next year. He was ably assisted by Lilley and Charters, his hard swimming, hard checking defensemen. "Doug" Bruce, the rover, playing his first year, made life unhappy for the opposing centres. "Paul" Hooper, one of the fastest centre men in the University, took a back seat to nobody, and was ably supported by Captain Ken Clarke and "Vic" Zachanko his hard shooting wings. Elongated "Russ" Eaton, Heller, Hollands and Hoag made life miserable for the opposing goalies with many a hard shot.

The freshmen who turned out for practices, Shapiro, Morgan and Pittis, will of necessity form the nucleous for next year's team—providing old man Nemises does not get some of the sophomore members of team—and they obtained some good idea of the game under the coaching of "Don" Fraser, who certainly turned out a creditable team from the material available at the beginning of the year.

W. A. Wood,
Manager.

JUNIOR SCHOOL BASEBALL TEAM

Spalding Cup Finalists

Back Row: A. Jacobs, A. McLaughlin, P. Purcell, L. Egar.
Middle Row: H. Turley, R. Waldon, H. Mason, A. Upper, R. Miller.
Front Row: B. Carveth (Manager), D. Cooke, W. Lowe, P. Hawker (Captain), J. Trosier, J. Dutton.

Junior School Baseball

Spalding Cup Finalists

This year, the Spalding Cup came as close to Junior School as it possibly could, without actually doing so. The team romped through its group of Jr. Meds and Jr. U.C. and entered the semi-finals with Jr. Vic and Sr. U.C. Jr. Vic were disposed of to the tune of 20-3 and 13-4, and Sr. U.C. by 14-10, these three wins cinching a place in the finals. Up to this point, the team scored seventy-eight runs to their opponents' twenty-five. The team continued their unbroken string of wins by defeating Sr. Vic in the first game of the finals, 12-7. Sr. Vic won the next two games, 9-1, and 6-1, despite the fact that they were outhit during the three game series. Sr. Vic had a splendid team of players who have been playing together for four years but one must admit that Lady Luck is quite an influential person—enough said!

Only three of the regulars had played ball in the gym before and only three actually stayed in the same position throughout the season, injuries playing havoc with the line-up. Miller, first-string catcher, received a severe hand injury in the second group game and Mason, who pitched the first game, caught McLaughlin in most of the remaining games. Waldon also caught three games when Mason's hands were in very bad shape from McLaughlin's speed ball pitching as his seventy-three strikeouts in the nine games of fifty innings testify. During this time, the team banged out 153 hits for 92 runs. The "regular" infield consisted of Hawker, captain, 1st; Cooke, 2nd; Waldon, 3rd; Egar and Purcell in the two shortstop positions; Upper and Carveth in the field; Jacob, Troster and Turley substituted in the infield and Dutton and Lowe were always on hand when needed.

The co-operation, fighting spirit and, above all, sportsmanship of the players, cannot be properly described in a few words. Memories of such qualities linger long after the won and lost column has been forgotten. Thanks a lot, fellows.

Bruce H. Carveth,
Manager.

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

OPERATING STATEMENT

APRIL 1, 1932 TO MARCH 31, 1933

SUPPLY DEPARTMENT

Sales			$12,116.96
Deduct—Cost of goods sold:			
Inventory, April 1, 1932	$3,478.50		
Less adjustment	239.89		
		$ 3,238.61	
Purchases		8,772.30	
		$12,010.91	
Less Inventory, March 31, 1933		2,307.71	
			9,703.20
Gross Trading Profit			$ 2,413.76

GENERAL OPERATING STATEMENT

Gross Trading Margin—Supply Department		$ 2,413.76
Deduct Salaries		1,352.00
Operating Profit after Salaries		$ 1,061.76
Add—Fees	$ 1,827.00	
Interest and Discount Earned	133.37	
School Night—Surplus	67.53	2,027.90
Available for Expenses and Deficits		$ 3,089.66
Deduct:		
General Expenses	$ 291.35	
Grants to Affiliated Clubs	185.23	
Donations	174.49	
Dinner—Deficit	305.16	
Election Expense	141.79	
School At Home	260.85	
Photographs	325.50	
Publications	997.24	
Depreciation—Office Equipment	50.00	
Depreciation—Smoking Room Furniture	10.00	
Insurance	22.60	
Printing and Stationery	20.56	2,784.77
Excess of Revenue over Expenditure to Surplus		304.89

UNIVERSITY OF TORONTO ENGINEERING SOCIETY

BALANCE SHEET

MARCH 31, 1933

ASSETS

CURRENT			
Cash		$ 152.84	
Bank—Savings		3,329.16	
Accounts Receivable	$ 635.64		
Employment	50.00		
Suspense—Returned Cheques	63.00		
	$ 748.64		
Less Reserve for Bad Debts	222.75	525.89	
Interest on Bonds—Accrued due	$ 50.00		
Premium on N. Y. Funds	10.00	60.00	
Inventory—Supplies		2,307.71	$ 6,375.60
INVESTMENTS			
Bonds—C.N.Ry. Guaranteed by Dominion of Canada			2,000.00
DEFERRED CHARGES			
Unexpired Insurance			17.60
FIXED			
Office Equipment		$ 859.24	
Less Reserve for Depreciation		680.00	179.24
			$ 8,572.44

LIABILITIES AND SURPLUS

CURRENT		
Accounts Payable	$ 1,215.00	
Bank—Current Overdraft	179.90	$ 1,394.90
Surplus as per Statement		7,177.54
		$ 8,572.44

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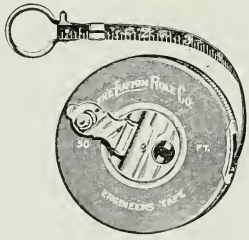

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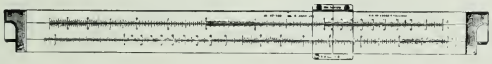

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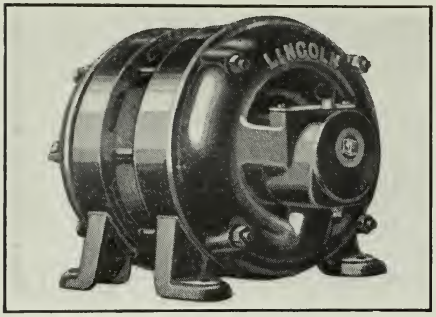

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